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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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Invention Propagation

Newcastle-upon-Tyne has created a very influential committee to help local inventors in the exploitation of their inventions. The committee is to be presided over by an ex-Lord Mayor of the city, who is supported by the Lord Mayor, important members of the local Press, the secretary of the Institute of Patentees and Viscount Ridley, the President of the Tyneside Industrial Board. From personal experience, there is no type of man who needs help more than the average inventor. Generally speaking, the inventor never quite knows what to do with his invention. There are four courses open to him in order to reap a reward for his efforts:—(1) He can make money by promoting a company; (2) by selling his invention outright; (3) he can grant licences; and (4) he can manufacture the article or conduct the process himself. Our experience is that the inventor usually desires to do all four, with a special tendency towards the creation of a works for doing the job himself. In doing so, he seldom realises that the businesslike conduct of a works is actually more important than the invention, and herein especially lies the usefulness of an authoritative committee. The fundamental principle is one worthy of emulation by other similar bodies. If such committees can attract the confidence of the local inventor, it will prevent the "hawking" of inventions and be a real benefit to the discoverer. Under existing conditions, the fact that an invention has been turned down by the representative of a group of financiers imposes the label that it is the scheme "so-and-so had no use for," irrespective of its real merit. It is true to say that the Tyneside Committee, or any other which may be formed, will not have an easy passage. There should be an immediate recognition of the fact that the great majority of Patented processes and machines are competitive, and in most cases efficiency in exploitation and manufacture is the final factor. There should also be recognition of the fact that it is preferable to assign the patent to an existing organisation, complete with all the modern adjuncts of an industrial concern, rather than to create a new concern sponsored by the committee. The committee would not do justice to the great mass of inventors by assuming too much liability for any one patentee. The most important factor from the inventor's point of view is that the very personnel of the committee ensures that he will get a "square deal," and that the advice he receives will be impartial and authoritative. The mental outlook of the inventor is, and always will be, a matter of extreme difficulty.

Education Plans

Before the general election the educational programme of the new Government, if returned, was issued as a special manifesto. It is intended that every child should have the best training of mind, of hand and eye, and of body from which he is capable of profiting. Of profound interest to industry is the announcement that the Government intends to raise the school-leaving age to 15, with a right to exemption between 14 and 15 for what is called beneficial employment. The interpretation of this phrase is to rest with the local education authorities, who, in granting exemptions, will be able to attach such conditions as they may think fit regarding hours, wages, and provision for further education. The Hadow scheme, in fact, to which we have previously referred, is to be completed. The educational ladder is to be widened by increasing free place or reduced fee provision at secondary schools and scholarship provision to the universities. An elaborate system of physical training is to be begun, and reinforced by a better school medical service and more nursery schools. That part of the provision relating to technical schools has also been elaborated in recent ministerial speeches. The broad plan is to bring buildings up to date and new schools are to be built in areas now inadequately served in this respect.

It is now stated that twelve million pounds are to be spent on technical education alone, to be spread over seven years, to bring us up to the level of our competitors abroad. We fear that much of this will go in buildings and equipment, and we think this is unfortunate, because technical education requires to be looked at in an entirely new way in this country, a way which makes buildings and equipment secondary. Even modern equipment is apt to get out of date in a few years, and our technical schools are littered already with the obsolete. The Board of Education is to co-operate with local authorities, but we see no promise of co-operation with industry. Such a scheme, to be successful, should be worked out in co-operation with the universities on the one hand and employers on the other. It must be said plainly that no mere extension of present technical education, however liberally financed, will bring us up to date and level with foreign competitors.

XUM

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Some Properties of Mould and Core Materials at Elevated Temperatures

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Referring to "Some Properties of Mould and Core Materials at Elevated Temperatures," Mr. Hudson is to be congratulated on undertaking this very important phase of the subject. I am well aware of the difficulty of obtaining suitable equipment, but am pleased to note that the first serious work to be carried out on my design of testing machine has been so fruitful.

I would like to suggest that the work would be incomplete without taking into account the effect of variation of ramming density. It is very likely that the excessive expansion of the sands referred to could be more effectively eliminated by controlling the ramming density than by any other means, and this in fact is to some extent common knowledge. Similarly for comparison of different materials the degree of ramming is not satisfactorily represented by apparent density of the test-piece, and I would suggest the following:—

$$\frac{\text{Apparent density of test-piece at temp. of test}}{\text{True density of sand as used}}$$

this being a measure of the air spaces in the sand test-piece and takes into account the distillation effect on the water and volatiles.

The double-compression method should, I think, be used for making the test-pieces, whether A.F.A. or not, for all serious research work of this calibre, as it is admitted that some sands ram harder than others and the A.F.A. drop-weight method is therefore unsuitable.

Fritting does not normally take place in iron-foundry work except in the case of, say, casting rollers of great thickness, and the cost of black-wash prevents the fritting action in dry sand. In spite of Mr. Hudson's remarks "that coal dust seems to play a very large part in preventing the grains fritting together and thus promoting the removal of sand from castings," green-sand work is difficult to fettle and has been largely discontinued in the writer's foundry for certain castings; whereas the same sand minus coal dust, used as dry sand, gives all that could be desired. On the other hand, I have, for some considerable time been using coal dust in core sand with improved fettling results. I would like to state that Mr. Hudson's previous findings have been confirmed on a large scale in the writer's foundry by using no new sand in dry-sand facing sand for six months, "Colbond" being used in controlled quantities.

It is a pleasure to see work of this quality being brought forward after so much talk of purely routine tests, and my own view is that undue importance attached to routine tests lately has impeded progress and that research is far more necessary.

As Mr. Hudson intends to continue this work the remainder will be awaited with interest.—Yours, etc.,

WM. Y. BUCHANAN,
Foundry Manager and Chief Metallurgist.

John Lang & Sons, Limited,
Johnstone, near Glasgow.
December 9, 1935.

THE WALES, MONMOUTH AND WEST OF ENGLAND BRANCH of the Institute of British Foundrymen held a propaganda meeting at Llanelly on December 6, when Mr. C. E. Richards presided, and a Paper on "The Manufacture of Steel by Electrical Processes" was given by Mr. Richardson, of Pontypridd. The meeting was well attended and several new members were enrolled.

Notice of Accidents

PROVISIONS OF 1906 ORDER EXTENDED

The Home Secretary has extended the provisions of the Notice of Accidents Act, 1906, requiring notice of accidents in factories and workshops to be given to an Inspector, to the following classes of occurrences, whether personal injury or disablement is caused or not:—

All cases of (I) Bursting of a revolving vessel, wheel, grindstone or grinding wheel moved by mechanical power; (II) Collapse or failure of a crane, derrick, winch, hoist, or other appliance used in raising or lowering persons or goods, or any part thereof (except the breakage of chain or rope slings), or the overturning of a crane; (III) Explosion or fire causing damage to the structure of any room or place in which persons are employed, or to any machine or plant contained therein, and resulting in the complete suspension of ordinary work or stoppage of machinery or plant for not less than five hours, where such explosion or fire is due to (i) the ignition of dust, gas or vapour, or (ii) the ignition of celluloid or substances composed wholly or in part of celluloid; (IV) Electrical short circuit or failure of electrical machinery, plant, or apparatus, attended by explosion or fire or causing structural damage thereto, and involving its stoppage or disuse for not less than five hours; (V) Explosion or fire affecting any room in which persons are employed and causing complete suspension of ordinary work therein for not less than twenty-four hours; (VI) Explosion of a receiver or container used for the storage at a pressure greater than atmospheric pressure of any gas or gases (including air) or any liquid or solid resulting from the compression of gas.

The Order (S.R. and O., 1935, No. 1046) extending the provisions of the Act is cited as the Dangerous Occurrences Notification Order, 1935, and comes into operation on January 1 next, from which date the Order of November 9, 1928, is revoked.

Publication Received

Foundry Practice. Issued bi-monthly by Foundry Services, Limited, 285, Long Acre, Nechells, Birmingham, 7.

The actual issue sent for review is No. 17. It is a four-page bulletin in which the interests of the practical worker are specially catered for. This particular issue contains short articles on the melting of pure nickel; the application of lithium and calcium as deoxidisers; an alloy suitable for castings used in connection with hydrochloric acid; the influence of lead on brass; and manganese bronze. The contents make very interesting reading, and the offer which the publishers make to put any of our readers on their free-mailing list is quite worth while accepting.

Imported Linseed Oil

The Treasury, on the recommendation of the Import Duties Advisory Committee, have issued the Additional Import Duties (No. 34) Order, 1935 (S.R. and O., 1935, No. 1193), increasing the specific duty on linseed oil from £3 10s. to £5 per ton from today (Thursday, December 12.) There is a duty of 10 per cent. in force under the Ottawa Agreements Act on foreign linseed, and, having regard to the increased imports of oil, the Committee are satisfied that the production of linseed oil in this country will be seriously endangered unless further assistance be accorded to the industry. The rate of duty now imposed will secure to the home manufacturers a protection equivalent at recent prices to about 10 per cent. *ad valorem*. Drawback schemes in respect of linseed oil used in further manufacture are in operation to assist consuming trades with export interests. A White Paper containthe Treasury Order and the Advisory Committees Recommendation is published by the Stationery Office (Cmd. 5040).

The Spelter Position

By "ONLOOKER."

Although rather overshadowed by lead, which has surpassed it in price during the present year, spelter has been extremely busy, and at the ruling quotation, viz., £15 10s., this metal begins to look cheap, for, in spite of the fact that demand has latterly died down, business is fairly brisk, and is likely to pick up again in the New Year. For something like twelve months now we have had no Zinc Cartel to hold things together, but 1935 has registered quite a good improvement in the outlook and producers seem to get on quite well without it. There is, of course, a measure of curtailment in force, and but for this values would not stand as high as they do to-day. Recently there has been talk of the cartel being revived, but the market does not appear to take the suggestion very seriously, and it is doubtful if anything will come of it at the moment.

The first ten months of this year return a total of 122,000 tons, in round figures, of spelter imported into this country, some 20,000 tons of which have come from foreign sources of supply, the remainder being derived from the Empire, mostly from Canada. For last year the comparative figure was 104,000 tons, with 22,000 tons of non-Empire metal, so that this year has scored an advance over last, although if zinc sheets are included the gain is reduced by 6,000 tons. When the import duty on spelter was adjusted in August it was hoped that foreign brands would flow in more freely, giving consumers the chance to return to "old loves," but so far this has not eventuated, and the Empire products continue to hold the field both as to high-grade and ordinary qualities.

As to the consumption of spelter in this country, a change has occurred during the last few years which has increased its use in some directions with corresponding decreases in others. Owing to the establishment of factories abroad and the increasing popularity of other methods of roofing, the call for galvanised-iron sheets has lessened, and it must be confessed that the outlook for this trade is not very bright. On the other hand the brass industries are busy, more spelter is being utilised for the manufacture of rolled zinc and the demand in connection with oxide is going up. This is all to the good, and now that the manufactured-zinc trade in this country has adequate protection it seems likely that any losses through a further decline in the needs of galvanisers will be offset by gains in connection with other activities.

The general level of quality in the brands of spelter now entering this country is high, for the place of the ordinary Continental G.O.B. has been taken to a considerable extent by debased electrolytic which may be relied upon to return 99 per cent. zinc content. There is, of course, also our home production manufactured by the distillation process, these brands being constant and reliable in quality, so that one way and another the British consumer does fairly well. Electrolytic or high-grade spelter, now available at a premium of £2, is still a strong favourite with most users in this country, and a big tonnage comes in every year from Canada, Australia and Rhodesia. Modern practice is all in the direction of production by the electrolytic method and Germany now has a large unit in operation at Magdeburg.

On the whole the outlook for spelter seems to be reasonably good, for any further increase in general trade would certainly be reflected in an improvement in the demand for this metal. There is, however, plenty of spelter available, and the modest reduction in stocks in this country has no significance, for producers are certainly ready, and probably quite willing, to put up their rate of output. On this score, therefore, much advance in price is unlikely, although a figure around £17 does not seem to be unreasonable.

XUM

British Ironfounders' Association

ANNUAL DINNER IN LONDON

A large and representative company attended the annual dinner of the British Ironfounders' Association, the British Bath Manufacturers' Association, and the National Light Castings Ironfounders' Federation, at the Hotel Metropole, London, on Wednesday evening, December 4. Mr. W. R. Blair, the chief executive officer, presided.

MR. GEOFFREY H. SHAKESPEARE, Parliamentary Secretary to the Minister of Health, proposing the toast of the British Ironfounders' Association and kindred organisations, congratulated them on the success they had achieved in becoming united in one section of a most important industry. The trade association was of comparatively recent growth in this country. Like many other things, it was a foreign import. It was the father and mother of the cartel that they saw abroad, but these cartels had many vices. They had grafted on these ideas the new English ideas, which would turn out a new form of association based on years of tradition and common-sense experience. Trade associations had done a great deal in fostering industries since the war. That particular association, he was sure, was fulfilling a useful function. It collected information and provided means for research. Individual cut-throat competition had greatly damaged industry in this country. They had now formed a sort of League of Nations applied to industry. "We in our humble way are nationalising politics by bringing in the experience of other parties, and I hope that will survive for many years to come. I congratulate you on improving the relations between employers and employees. You have had very little industrial disturbance. Baths are one of the things in which I am vitally interested. Baths were once the luxury of the rich. Now they are the necessity of the poor. You have achieved a considerable measure of stability. It is a great mistake for anyone to imagine that in these days the consumer has anything to gain by cut-throat prices. The fact that you have stabilised prices, giving you no more than a reasonable profit, will enable you to look forward to a certain measure of security. At the same time, do not forget the consumer. You will be judged by the services rendered to the community.

"On the housing policy of the Government depends your interests and your prosperity. How can we continue the output of houses, which last year was 327,000? The annual average pre-war output was something like 100,000, so you can see what an enormous increase in production has come from a strong Government. Two hundred and eighty-seven thousand houses were built by private enterprise. We cannot expect to continue at that rate, and, indeed, you will find from the figures that there is a slight falling-off, but if we could continue at that rate, I am not quite sure it would be wise. Something between 250,000 and 300,000 decent houses a year would be satisfactory. If private enterprise does fall off, as I believe it will, the Government will come in by increased activity in its slum-clearance campaign, and its campaign against overcrowding. We are already building just under 40,000 dwellings to re-house slum tenants. We have been able to accelerate, and this great campaign is a big step forward. I am sure of this, that any slackness of trade due to the falling-off of private enterprise will be taken up by the building of houses to prevent overcrowding. We hope next year that something like 70,000 new buildings will be erected to re-house slum tenants and prevent overcrowding. Only a National Government can tackle the housing problem as it should be tackled. Given a continuance of a strong, stable Government, there can be 10 years of active house production."

CAPT. H. J. KENNARD, R.N., responding, expressed the general pleasure that was felt by the Associations, and regretted that Mr. Shakespeare had to return immediately to the House. Mr. Shakespeare's departure was accompanied by the whole assembly singing "Will ye no' come back again."

MR. H. W. ROGERS, replying to the toast of the guests, said the British Ironfounders' Association was doing its best to uphold price agreements and to organise the trade. They had learned above all the value of co-operation between the manufacturers and merchants. There was no need for any of them to be afraid of the future. Prosperity was coming to them, but there must be less competition, and they must hold on to what they had fought for, in face of competition.

MR. T. DUDLEY, of Tipton, speaking on behalf of the merchants, appealed for consideration for the workman, so that he could have the necessities of life which were necessary to maintain the strength and quality of the work supplied to the merchants.

Amongst those present were the following:—A. W. Steven (Allied Ironfounders, Limited); J. Sharp (James Allan, Senr., & Son, Limited); J. N. Deas (Thomas Allan & Sons, Limited); J. B. Ballantine (A. Ballantine & Sons, Limited); J. G. Petrie (Bennett's Ironfoundry Company, Limited); G. Macdonald (Bo'ness Iron Company, Limited); W. D. Joslin and D. A. Parfitt (Borough Engineering Works); W. D. Muirhead and A. Young (British Bath Company, Limited); Wm. Wright (Burnbank Foundry Company, Limited); D. F. Campbell (Burton Foundry Company, Limited); G. L. Anderson (Camelon Iron Company, Limited); J. Cameron (Cameron & Roberton, Limited); R. Carrick (Carrick & Foster, Limited); H. Bell (Carron Company); A. Chatwin (Chatwins, Limited); T. O. Lander (James Clay (Wellington), Limited); C. W. Edwards and A. Wareham (Coalbrookdale Company, Limited); J. B. Brand (Crosthwaite, Limited); T. M. Scott (Dorrator Iron Company, Limited); H. Taylor (Excelsior Foundry Company, Limited); G. Scotland and Capt. H. J. Kennard (Falkirk Iron Company, Limited); J. Mitchell (Grahamston Iron Company, Limited); J. H. Calder MacLeod and J. M. Primrose (Grangemouth Iron Company, Limited); W. Hodkin (Greenside Foundry Company, Limited); J. F. Buchanan (Hammond Lane Foundry Company, Limited); J. M. Jackson and J. Jackson (Jackson, Elphick & Company, Limited); W. Rennie (David King & Sons, Limited); R. Dickson and A. C. Wells (Lion Foundry Company, Limited); Col. Macfarlane and D. Sharpe (Walter Macfarlane & Company, Limited); C. W. Dawson and H. V. Shelton (Newton, Chambers & Company, Limited); Capt. S. F. Corby (Park Foundry (Belper), Limited); J. Shaw (Planet Foundry Company, Limited); A. F. Shanks (Shanks & Company, Limited); W. H. Watkins, J. H. Jones and J. L. Sturrock (Sinclair Iron Company, Limited); S. Smith and S. Smith, Jun. (Sam Smith & Sons, Limited); A. Shirlaw and G. Sheffield (Southern Foundries (1926), Limited); A. J. Monk (Warrington Light Castings Company, Limited); L. H. Crump (Watford Foundry Company, Limited); J. Hogg (Welwyn Foundry Company, Limited); T. R. C. Whyman (Whyman's Foundry Company, Limited); J. S. Mathieson (London Scottish Foundry Company, Limited); Fletcher, Russell & Company, Limited; Wilsons & Mathiesons, Limited); A. P.

(*Concluded on page* 432.)

THE ANNUAL BANQUET OF THE BRITISH IRONFOUNDERS' ASSOCIATION, HELD LAST WEEK AT THE HOTEL METROPOLE.

Verein Deutscher Eisenhüttenleute

75th ANNIVERSARY OF FOUNDATION

The Verein deutscher Eisenhüttenleute on November 30 and December 1 held their annual meeting at Düsseldorf at which the Verein celebrated the 75th anniversary of its foundation, as well as the opening of the new laboratories of the Kaiser-Wilhelm-Institut für Eisenforschung. Over 1,000 members and visitors representing all branches of industry, commerce and the professions were present. The Verein, actually the second of its kind in Germany, as the Verein deutscher Ingenieure was founded some few years earlier, was formed at Düsseldorf on November 3, 1860, as the result of the initiative of a few metallurgists and iron and steel makers. A small committee of three was entrusted at this meeting with the work of evolving a constitution and articles of association of the new venture, the recommendations and drafts of this committee being formally adopted on December 14, when the Association took the title of "Technischer Verein für Eisenhüttenwesen." The main purpose of the Association was "to foster and further the development of practical metallurgy, to organise the systematic interchange of ideas and knowledge in the interests of the industry through meetings, discussions and publications and by the collection and correlation of experimental and practical data, to further the practical side of the industry and the utilisation of iron in all its forms." As its official organ the Verein chose the technical journal "Berggeist," then published at Cologne.

Owing to a partial community of interests the Verein early entertained the idea of becoming affiliated to the Verein deutscher Ingenieure, and on January 1, 1862, it became a branch association of the older organisation, although retaining a large measure of autonomy. The Verein then acquired certain important facilities, mainly as regards the publication of its Papers and transactions. For nearly two decades the affiliation was maintained, but towards 1880 technical and economic conditions having undergone fundamental changes, the Verein again became independent. At a meeting on November 20, 1880, it was decided to make the Verein completely autonomous again, with the title of the "Verein deutscher Eisenhüttenleute," a title which it still retains. The executive of the Verein did not change, thus ensuring continuity in policy, Carl Lueg, of the Gutehoffnungshütte, Oberhausen, remaining president and C. R. Petersen the vice-chairman. From December 14, 1879, until his death in 1905 Carl Lueg directed the administration and organisation of the Verein, his eminent services being commemorated in the foundation of the "Carl Lueg Memorial Medal" in 1903, to be bestowed annually for eminent technical and/or industrial services to the iron and steel industry. After Lueg's death, F. Springorum, of the Hoesch iron and steel works, became chairman, and remained in office until 1917, when A. Vögler, of the Vereinigte Stahlwerke, Dortmund, assumed office.

In 1896, with the aid of a fund provided by F. A. Krupp, the Verein was able to acquire its own premises in the Jakobistrasse, Düsseldorf, which were gradually expanded to include neighbouring property. In the course of a few years, however, demands for more space became so insistent that larger premises had to be acquired in the Breite Strasse in 1910, a development only rendered possible by the munificence of iron and steel industrialists and the city of Düsseldorf. In the new building an ample library was collected and a reading room provided. The technical committees of the Verein are permanent bodies for dealing with the more specialised problems of the industry. The committees at present in existence with the years of their establishment are:—Blast-Furnace Committee, 1907; Steelworks Committee, 1911; Chemistry Committee, 1911; Coke Committee, 1912; Rolling-Mill Committee, 1913; Historical Committee, 1913; Machinery Committee, 1918; Ore Committee, 1919; Materials Committee, 1920; Committee for the Utilisation of Blast-Furnace Slag, 1921; Educational and Training Committee, 1921; and the Committee for Works Management, 1924. In collaboration with the Fachverein des Giessereigebietes, a Technical Committee for Foundry Practice was also formed in 1919, while the Wärmestelle Düsseldorf, dealing with all heat-economy problems, was formed after the war as a result of the shortage of coal and the need for fuel economy.

Kaiser-Wilhelm-Institut fur Eisenforschung

During the war the German iron and steel industry established an institution for scientific research on all iron and steel problems, the whole of the planning, organisation and management of the institution being placed in the hands of the Verein. This institution, the "Kaiser-Wilhelm-Institut für Eisenforschung," was recently affiliated to the Kaiser-Wilhelm-Gesellschaft zür Förderung der Wissenschaften. In 1934 the erection of spacious new buildings to house the Institut was commenced and recently completed. Part of the recent meeting was devoted to the formal opening and inspection of the new Institut. The new buildings have been suitably designed to house research plant, and the laboratories are planned on a liberal scale. In addition to administrative offices, library, registry, a large reading room, which can also be used for meetings, and a council chamber, the main building contains physical, chemical and metallographical laboratories, with a large number of small laboratories for individual workers. The second building of the Institut houses a mechanical department, with testing machinery, drawing office and workshops.

Landmarks in the History of the Verein, 1860 to 1935

1860. December 14.—The Technische Verein für Eisenhüttenwesen was founded at Düsseldorf.
1861.—The 1,000 cwt. hammer, "Fritz," put into operation by Krupp.
1862.—First Bessemer-steel works in Germany started at Krupp's steel foundry, Essen.
1864.—Emil and Pierre Martin first succeeded in melting "hearth steel" in the Siemens regenerative furnace.
1867.—The "slag notch" discovered by Lürmann first used at Osnabrück.
1869.—At Essen Fr. Krupp put the first open-hearth furnace in Germany into operation. Borsig at Moabit started the second in 1870.
1877.—First armour plate made in Germany by the Dillinger Hüttenwerke.
1879.—The first basic charges blown in in Germany by the Rheinische Stahlwerke and the Phœnix works.
1879.—The first grooved rail made by the Phœnix works at Ruhrort.
1879.—C. W. Siemens built the first electric furnace and in the following year succeeded in making steel by the electric process.
1882.—F. Burgers made the first trials with carbon and coke bricks in blast-furnace structures.
1883.—H. Sack invented the universal mill for wide-flanged joists, simultaneously with J. S. Seaman, of Pittsburgh.
1885.—The Mannesmann brothers invented their patented process for making seamless tubes.
1886.—F. W. Lürmann first suggested the possibility of using blast-furnace gases in gas engines.
1894.—H. Goldschmidt discovered the thermit process.
1894.—The Bertrand-Theil process was patented.
1895.—The Gasmotorenfabrik Deutz started up the first 12-h.p. blast-furnace gas engine at Hörde. Two months later an 8-h.p. Delamare-Debouteville gas engine was started up at Seraing.
1896.—Henry Grey started rolling wide-flanged joists at Duluth. Max Meier introduced the process at Differdingen several years later, making many improvements.
1898.—Emilio Stassano attempted to melt iron ore in the electric furnace, but only succeeded in 1902 after making radical alterations in the design of his furnace.
1898.—At Hörde a 600-h.p. gas-driven blowing engine was put into operation, and at Seraing a 200-h.p. engine.
1900.—Héroult patented his electric steel furnace. The first electric-steel charge was cast in Germany in 1906 at the R. Lindenberg steelworks by the Héroult-Lindenberg process.
1907.—First use of coke-oven gas in open-hearth furnaces in Germany at the Upper Silesian Hubertushütte.
1910.—Open-hearth furnaces in Germany first equipped with recuperators simultaneously at the Phœnix works, Duisburg-Ruhrort, and Illinois Steelworks, Chicago.

Presentation to Mr. H. H. Summers

Members of the staff of the iron, steel and brass foundry section of Messrs. John Summers & Sons, Limited, Hawarden Bridge, at their annual dinner presented to Mr. H. H. Summers a silver inkstand, the gift of the employees of the Foundry, to mark his 70th birthday, which he celebrated earlier in the year. Mr. R. Gill, who made the presentation, said that they hoped that the firm would always be a family one, and that the traditions so soundly established and upheld would be continued. Mr. H. H. Summers, in reply, said that it was his desire for the concern of John Summers & Son to remain a family concern, and it was also the desire of his sons. There had been in the last few months a distinct awakening of business, and they had found it slowly growing in all directions. People to whom they supplied small quantities were now taking more. They were working more mills and turning out more steel than ever they did before. His son had just returned from America and had seen the wonderful things they were doing there. With their new developments they might look forward to having full employment for quite a long time to come. They felt that they could with more confidence proceed with schemes which they had always had in mind, but which they had hesitated to start.

British Ironfounders' Association

(*Concluded from page* 431.)

Harrop and Col. H. W. O'Brien (Yates, Haywood & Company, Limited); E. Price (Yew Tree Ironworks Company, Limited); G. H. Berry (International Bath Association, Limited); W. E. Beaney (Wilmer & Sons, Limited); C. L. Burn (Burn Bros. (London), Limited); H. Cheetham (Rowe Bros. & Company, Limited); O. B. Clausen (Gussemaille Syndikat G.m.b.H.); P. W. Cummings (Kayll & Company, Limited); — Dodds (British Bath & Enamelware Company, Limited); P. G. Donald and B. Donald (Associated Builders' Merchants, Limited, and Rownson, Drew & Clydesdale, Limited); T. Dudley (Thomas Dudley, Limited); W. J. Farrant (John Bolding & Sons, Limited); V. C. Faulkner (Editor of THE FOUNDRY TRADE JOURNAL); P. Foddering (Builders' Merchants' Alliance, Limited); J. N. Foulkes (A. D. Foulkes, Limited); P. L. Garrett; J. A. Glendinning (John Glendinning & Sons); F. H. Hall (Hall & Rice, Limited); H. Hawkins (Alexr. Hawkins & Sons); R. Hellyer (Dent & Hellyer, Limited); V. Jobson (Qualcast, Limited); E. Jones (Standard Range & Foundry Company, Limited); T. Jones (Pontypridd Ironmongery Company, Limited); H. Mason (Harry Mason & Sons, Limited); S. Neve (National Federation Builders' Merchants); J. W. Rains (J. W. Rains, Limited); S. Roberts (Pontifex & Emanuel); A. E. L. Robey (Cakebread, Robey & Company, Limited); H. W. Rogers (Builders' and Plumbers' Merchants' Association); H. C. Sargent (British Bath & Enamelware Company, Limited); C. L. Scott (Aga Heat, Limited); G. Shakespeare, M.P. (Ministry of Health, Parliamentary Secretary); Sir Berkeley Sheffield (Southern Foundries (1926), Limited); H. Smith (Ironmongers' Federated Association); J. B. Forbes Watson (National Confederation of Emp. Organs.); F. G. Williams (Ironmongers' Federated Association); W. T. Wren (Aga Heat, Limited).

Cast-Iron Pulleys for Wire Ropes

The influence of cast-iron pulleys on the life of wire ropes formed part of a recent investigation by the Wire Ropes Research Committee of the Institution of Mechanical Engineers. The question of pulley in relation to rope life is obviously important, for a pulley possessing a high resistance to wear may not necessarily give a long life to the wire rope, which is, in this instance, the most important factor. A number of tests have been carried out by the Committee, and in the following extract from the Report, chilled-iron pulleys for the conveyance of wire ropes under tension are shown to be inferior to ordinary cast-iron pulleys from the point of view of rope life. In the results, the number of bends to failure is taken as an indication of the life of the rope.

Extract from the Report of the Wire Ropes Research Committee

Some users, particularly in collieries, favour chilled-iron pulleys for wire ropes, contending that their use allows a longer life for the rope than when it works over ordinary cast-iron pulleys. It is difficult to justify this view, because the balance of advantage seems to be against the chilled pulley. A hard surface to the pulley tread would appear to lead to greater resistance to indentation by the wires, with greater bearing stress between the wires and the pulley, and also, probably, greater bending stress. A certain amount of bedding of the wire into the metal groove must give an increased bearing area, and probably relieves the sharpness of the bend where it is most severe, at the inner side of the rope adjacent to the pulley. It is not possible to cast chilled-iron pulleys to fit the ropes, nor is it practical to grind the grooves, so chilled grooves are larger than the ropes used in them. It follows that a rope touches only the bottom of a groove, with a small bearing area and high bearing stress, in addition to which the pressure of the sheave must tend to force the strand, in contact with the pulley, between the adjacent strands which are not supported in the groove at this point, so the rope is wedged out of shape and tends to flatten.

The benefits which are likely to be derived from the adoption of chilled pulleys are both due to reduced wear of the pulley tread. The pulleys should last longer, but the gain on account of the hard surface may be offset by the smaller area over which wear takes place. The other point is not so obvious. The Second Report included the results of tests which showed that a rope had a longer life when it was used dry that when it was lubricated, a most unlooked-for result which is probably still doubted by many rope users. It is a phenomenon which has no obvious explanation, but it has been suggested that a lubricant may act as a carrier for particles worn from the pulley and wire and so lead to an increase of the grinding action and the resulting wear of the wire. This local wear of a wire not merely reduces the wire section; it is often accompanied by a fracture perpendicular to the axis of the wire. If the use of a chilled pulley leads to a reduced wear, it follows that the grinding referred to is also reduced, and in this respect the rope is benefited.

Many tests were made to compare the life of ropes on chilled- and on ordinary cast-iron pulleys. Three ropes were obtained for this purpose, the data for these ropes being as follow:—Rope No. 24: 1-in. circumference; 6 ×19 construction; ordinary lay; tensile strength, 100-110 tons per sq. in.; guaranteed breaking strength, 3.4 tons, or 7,620 lbs. Rope No. 25: 1-in. circumference; 6 × 7 construction; ordinary lay; tensile strength, 100-110 tons per sq. in.; guaranteed breaking strength, 4.2 tons, or 9.400 lbs. Rope No. 26: 2-in. circumference; 6 × 19 construction; ordinary lay; tensile strength, 100-110 tons per sq. in.; guaranteed breaking strength, 13.7 tons.

Pulleys were used in pairs, and were of similar dimensions, one being of ordinary cast iron and the other chilled. In each case the groove was much larger than the test rope, so in some cases the rope life on a cast-iron pulley with a groove to fit the rope was determined for comparison. The test results appear in Table I. Other pulleys were available, but it did not appear to be necessary to pursue this matter further. On the whole, a chilled pulley was inferior to a similar cast-iron pulley, chilling giving no benefit so far as the rope was concerned, further to which a cast-iron pulley could readily be turned to fit a rope, and so could ensure a much greater endurance.

TABLE I.—*Comparison of Chilled and Cast Iron Pulleys.*

Rope No.	Dia. of pulley at bottom of groove. In.	Rope tension. Lbs.	Bends to failure.		
			Chilled iron pulley; groove 0.72-in. radius.	Cast-iron pulley; groove 0.60-in. radius.	Cast-iron pulley; groove to fit rope.
24	6	380	150,166*	152,442*	480,075†
24	6	304	158,427†	234,824†	—
			Groove 1.12-in. radius.	Groove 1.06-in. radius.	
24	12	1,270	85,700	150,125	—
24	12	950	254,466	253,865	—
25	12	1,175	88,327	159,795	—
25	12	785	181,350	352,677	—
26	12	1,277	123,675	116,269	239,683

* Broken. † Rope will not carry load.

The Committee have also investigated the relationship between rope life and the material used for the pulley groove. It will be appreciated that from an economical point of view both the wearing properties of the pulley and the life of the rope have to be considered, a pulley giving the highest wear resistance and the longest rope life being most desirable. The results show that cast iron was the best metal which fulfilled these conditions. A plastic wood pulley tread, however, gave by far the best results.

It has been shown that chilled-iron pulleys do not permit so long a rope life as cast-iron pulleys. Other experiments have indicated that the material which forms the pulley groove is an additional factor which affects the life of a rope. This matter has been investigated, and the fact that pulley wear should not be great has not been overlooked. Similar pulleys were cast in different metals, and in addition cast-iron pulleys were made with an under-cut groove which could be filled with appropriate materials. All pulleys were grooved to fit the rope in use, and the ropes were lubricated. The test results and other data are set out in Tables II, III and IV.

TABLE II.—*Material for Pulley Grooves.*

Rope 19 : 6 × 6 × 0.026 in. on soft-core wire to the strand; tensile strength, 100—110 tons per sq. in.; Trulay, ordinary lay; guaranteed strength, 4.160 lbs.; pulleys, 6 in. in dia. at the bottom of the groove; rope tension, 520 lbs.

Pulley Material.	Bends to failure.	Wear of pulleys (in order of numbers).
Aluminium ..	221,754	Most worn, 5.
Cast iron	207,370	Least worn, 1.
Brass	197,284	More than gunmetal, 4.
Phosphor bronze	183,750	Slightly more than cast iron, 2.
Gunmetal.. ..	180,552	Medium, 3.

In this series, cast iron gave excellent results. Although the number of bends on cast iron were rather less than those on an aluminium pulley, this fact was more than compensated for by the small wear of the pulley, the wear being greatest with aluminium.

TABLE III.—*Material for Pulley Grooves.*

Rope 24 : 6 × 19 :: 0.021 in.; 1-in. circumference; tensile strength, 100—110 tons per sq. in.; ordinary lay; guaranteed strength, 7,620 lbs.; pulleys 6 in. in dia. at bottom of groove; rope tension, 380 lbs.

Pulley material.	Bends to failure.	Wear of pulley.
Plastic wood, filled	2,040,000*	—
Aluminium ..	1,026,208	Very bad.
Phosphor bronze	989,580	More than cast iron.
Cast iron ..	836,548	Very little.
Gunmetal.. ..	694,520	Moderate.
Brass	609,072	Bad.

* Only ten wires broken.

Here, again, aluminium gives the longest life to the rope of all the metal grooves tried, but the pulley tread was worn very badly. Phosphor-bronze was best and cast iron a moderate second. A groove filled with plastic wood gave excellent results, and each wire formed its own bed. Experiments were also made using larger pulleys which permitted higher tension. The results are given in Table IV.

TABLE IV.—*Material for Grooves of Large Pulleys.*

Rope 24, as above in Table III; pulleys 10 in. in dia. at bottom of groove; rope tension, 762 lbs.

Pulley Material.	Bends to failure.	Wear of pulley.
Plastic wood, filled	1,022,000*	Rope bedded.
Aluminium ..	823,500†	Bad.
Cast iron	714,800†	Slight.
Gunmetal.. ..	485,738	As before (Tables II and III).
Brass	420,700	As before (Tables II and III).
Phosphor bronze..	397,416	As before (Tables II and III).

Rope tension 950 lbs.

Pulley material.	Bends to failure.
Cast iron	400,300†
Plastic wood, filled	1,000,000§

* No wire broken. † Broken. ‡ Not carry load. § Only one wire broken.

The tests show that the life of a rope is affected by the material which forms the pulley groove and that cast iron allows a long life without excessive wear of the pulley. It appears that the crushing and bending stresses in the wire are reduced if the wire is bedded in the groove, so the use of a semi-plastic or elastic lining for the groove is indicated, but the material should not cut or wear. A moderately-hard rubber seemed to be the ideal material until it was found that the manufacturers could

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Foundry Selling Practice

THE OVERSEAS SALESMAN

By ERIC N. SIMONS

It is too often supposed by founders that the type of salesman who succeeds, or seems likely to succeed, in selling their castings in Great Britain is the right kind of man to send overseas as their representative. Nothing could be farther from the truth, and it is in this direction that many founders have broken down hopelessly. A bad choice of overseas salesman is not only expensive and creative of innumerable difficulties, it is actually perpetually harmful to the business itself. It happens far too frequently that men are sent out overseas to sell castings for the sole reason that they have a knowledge of the language of the land to which they are sent.

One factor that has to be borne in mind is the intensity of competition for overseas orders. Even in those countries where exchange restrictions and import duties do not operate, or operate less severely, the difficulties of selling are enhanced by factors not obtaining so extensively at home. Take the case of New Zealand, for example. Here is a country with a comparatively small population, very little industrialised, and offering only a limited market, at the best of times, for the founder. Nevertheless, as every United Kingdom salesman in New Zealand can tell, competition for what business there is is exceptionally intense. There are not only British firms competing through their representatives and agents; there are also Americans and even Germans.

The lot of the overseas salesman is hard for a special reason. He has not only to obtain orders for castings in the face of terrific competition, but he has to do it in a manner that preserves the prestige and dignity not only of his employers, but of his country, and its manufacturers. The overseas salesman figures in the minds of his customers not merely as the salesman for a United Kingdom founder, but as a characteristic sample of the home land. Any errors he commits, whether of deportment or demeanour, are, therefore, doubly harmful. That is why it is not sufficient to engage a man for overseas on the strength of a few paper qualifications, or because he speaks the language, or because he went to the same scool as the directors. He must possess in full measure the essential qualities that fit a man for overseas salesmanship.

These qualities are numerous. First and foremost, the salesman should possess a comprehensive and intimate knowledge of the particular country or territory overseas in which he is to operate. Next, he must be familiar at first hand with the castings he will have to sell. Thirdly, he must have the character and ability that enable him to understand and execute the sales policy of his firm, and he must also be able to deal with the specific type of customers on whom he will have principally to call. In effect, he must be, in every sense of the term, a builder of business, both national and local, not simply a taker of orders. The distinction is important, and its significance must not be overlooked.

A Knowledge of Politics

Furthermore, the overseas representative must possess a sound education, and adequate general knowledge. The reason is that customers abroad will ask him for information on matters very much wider in their general purport than the technicalities of his castings. In Great Britain, where the ordinary buyer has not time or inclination to take a great interest in foreign politics—where, in fact, knowledge of foreign affairs is confined to specialists or amateur enthusiasts, the attitude towards these things is apathetic and incurious. It is only too often overlooked, as a result, that overseas this apathy is less familiar. What Greece does may appear of very little importance or interest to the ordinary British buyer, aware of his own country's power and prestige. But what Great Britain does and thinks is of immense interest and importance to every business Greek, because of our country's influence on business and economic movements and conditions.

The overseas salesman is, therefore, assumed to possess knowledge of his country's attitude towards Greece, or Greek affairs, or Near Eastern matters. He will be asked by Greek buyers questions as to England's foreign policy, the grouping of her political parties, the aims of our politicians, and so on. Mere hazy, flabby generalisations such as the "man in the street" utters will not do. The average commercial Greek will be found sufficiently aware of broad general matters of British economics and politics to be aware when rubbish is being talked, and what is true of Greece is true of a great many lands. Greece is only mentioned by way of example.

The overseas salesman who relies on one morning paper alone, with one notable exception, for his news will soon find himself exposed to ridicule abroad. There, his customers are athirst for first-hand information, detailed and accurate. They themselves read two or three newspapers of varying attitudes. They demand exposition of United Kingdom matters—not plain statements of prejudice, or trashy dogmatism.

Another requirement of the overseas salesman is a general familiarity with the economic foundations of United Kingdom manufacturing and founding. He will often be called upon to convince customers that United Kingdom business methods have reason behind them, and are not inferior in essence to American, German, or Japanese methods. He may have to begin selling his firm's castings by selling the idea of his own country. Therefore, he must be a man whose honesty is unassailable. In brief, his moral character demands a far closer scrutiny than is usual in the case of a home representative, for the simple reason that his firm will have to rely so greatly upon him. He operates at a distance, and can never report so expeditiously, nor be observed and controlled so closely, as the home salesman.

Social Qualifications

In general, overseas salesmen must have certain minimum social qualifications, to enable them to feel no diffidence in rubbing shoulders with their customers. The sales manager of one large foundry declared once that he would never appoint as overseas representative a man whom he could not take home to dinner. Overseas, the personal element comes into play in business much more extensively than at home, and the prestige of any accredited Briton almost invariably means a great amount of social functioning in the course of his work.

Tact and courtesy are, for this reason, necessary. The salesman must avoid that self-righteous praise of Great Britain—implying contempt of the land in which he works—so frequent among Britons overseas. He must abstain from ridiculing or harshly criticising the manners or principles of the territory in which he works. His task is to represent his foundry, not to bewail the habits and methods of the foundry's customers.

In the Latin lands, particularly, is courtesy indispensable. Customers expect a salesman to remove his hat. They like him to call and bid them farewell before he leaves their town, if he has spent any length of time there. They like to feel that he remembers them, and if he sends them a card or letter of personal character occasionally, he will find this appreciated.

In general, the plodding, dignified Briton gets on better abroad than the extremely brilliant, but temperamental, man. The latter pulls orders at home because he has often developed a special manner and method adapted to his particular line of castings. Sent overseas, his method and manner frequently bring failure, and he lacks the elasticity to evolve fresh methods.

Discretion and judgment are essentials to the overseas salesman. Occasionally he may have to choose sub-agents or agents, or organise branch houses. This demands a certain skill in choosing men and estimating situations, so that he shall not pick untrustworthy agents or set up in unsatisfactory business centres.

Britons Preferred as Salesmen

Despite many theories to the contrary, the best representative for a United Kingdom foundry is a Briton. Though an Austrian, for instance, may speak German better, and will know more about Austria than a Briton, it is not thereby made certain that buyers will purchase from him. His calls will not be so stimulating to them. His own prestige will be less great. They may know his antecedents or his opinions, and dislike them. If a Briton errs, some allowance is made for him because he is a foreigner. If a native makes mistakes, he meets no such leniency. Buyers overseas are always interested in meeting a Briton.

Nevertheless, the salesman must be able to sell. Some foundries train their overseas representatives for a couple of years before sending them out, one year in the foundry, another in selling at home. To be familiar with the language of a country is a valuable asset, but other assets mentioned earlier are as important. Accuracy and care are requisites not to be overlooked. When orders for castings have to be sent long distances, it is essential that their details should be exact at the beginning, preventing errors and the consequent, often bitter, disputes. In arranging contracts or taking payments, overseas salesmen must also ascertain that the proper formalities have been carried out in accordance with the laws of the country. Many representatives have been over-reached in this manner by dishonest agents or customers.

The salesman overseas must know or learn the Customs duties and shipping charges on the castings he sells. He must be familiar with the principal transport routes and times, in order to be able to tell the customer when and how the castings will reach him. He must know how to travel about the country quickly and cheaply, and, lastly, he must report regularly to his firm, and arrange matters so that their communications to him are received safely and in proper time.

Cast-Iron Pulleys for Wire Ropes

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not offer a rubber mixture which was suitable for use with a lubricated rope. Then plastic wood was tried as a lining, with remarkable results. The plastic wood is readily worked into a recessed groove and can be turned a day or so after its application. A pulley could be re-treaded in place, or split tread could be stocked for renewals and held in position on the pulley by a side flange and set screws. The plastic wood allows the rope to press in slightly and form a bed for itself, which no doubt accounts for the excellent test results obtained with this type of pulley. The earlier tests showed the superiority of plastic-wood treads, so the last pair of tests was made to emphasise this by breaking down the rope more quickly through higher tension on a cast-iron pulley, whereas the rope working on plastic wood was practically undamaged after two and a-half times the number of bends which caused failure on the cast-iron pulley.—Bulletin of the British Cast Iron Research Association.

The Institute of British Foundrymen

LONDON BRANCH ANNUAL DINNER

The members of the London Branch of the Institute of British Foundrymen and their many guests spent a delightful evening together at the Charing Cross Hotel, London, on Friday, December 6, the occasion of the fourteenth Annual Dinner of the Branch. A most pleasing feature of the evening was the fact that Mr. F. O. Blackwell, the Branch-President, whose activities during the early part of the session have had to be curtailed by reason of illness, was able to attend and to preside. To have been forced to "slow down" during his period of office as Branch-President must have been as deeply regretted by himself, so active a man, as it was by his colleagues; and it was a matter of great satisfaction to them all that on this occasion he was able to be present to occupy the position to which they had elected him. Mr. A. S. Beech, the immediate Past-President of the Branch, was also welcomed back after a brief absence due to illness.

The guests of the Branch included Mr. P. J. Hannon, M.P., Mr. J. E. Hurst (President of the Institute), Mr. Barrington Hooper, C.B.E. (Managing Director, THE FOUNDRY TRADE JOURNAL), Dr. C. J. Smithells (Chairman, London Section, Institute of Metals), Mr. K. W. Bridges (of Messrs. F. W. Bridges & Company, who organised the Engineering and Shipping Exhibition, in conjunction with which was held the Foundry Trades Exhibition this year), Mr. C. W. Bigg (Junior Vice-President of the Institute), Mr. Tom. Makemson (General Secretary), Mr. J. G. Pearce (Director, British Cast Iron Research Association), and Mr. J. H. Coupe (a member of the Council of The Institute of Vitreous Enamellers).

Many stalwarts of the Branch, of course, were present, including its two Vice-Presidents, Mr. V. Delport and Dr. A. B. Everest; and Mr. Wesley Lambert, C.B.E., and Mr. V. C. Faulkner (Past-Presidents of the Institute); Mr. W. B. Lake, J.P. (Hon. Treasurer of the Institute); Mr. J. W. Gardom (Convener of the Technical Committee of the Institute); Mr. A. S. Beech; Mr. H. O. Slater, and Mr. C. H. Kain, all of whom have served as Branch-Presidents.

During the evening an excellent programme of music and other entertainment was provided; it was described by Dr. Smithells as the best interspeech entertainment he had experienced at a function of this kind.

The Speeches

Following the loyal toast,

MR. P. J. HANNON, M.P., proposed "The Institute of British Foundrymen," and emphasised, in the first place, the profound consequence of the activities of the Institute, over nearly a third of a century, to the basic industries of the country. Nothing had been more remarkable in our industrial history during recent years, he said, than the intensification of industrial research; the measure in which scientific investigation of possibilities and devices of development in the expansion of enterprise had been carried on was an outstanding feature in the story of our industrial development. All the great changes which had taken place in the vitality of constructive enterprise in this country during the past generation or from the beginning of the present century had in large measure centred around the application of scientific inquiry to possibilities of new discovery, new processes, the elimination of waste, the introduction of more economical methods of production, and, generally speaking, of co-ordination of effort in bringing the whole sphere of production to a more highly competitive level in face of the whole world. Technology in metal and alloy production had been raised to a very high standard consequent upon the work of the Institute. Since it had received its Charter, in 1924, it had been carrying on, in consultation and co-operation with various other institutes and societies concerned with the metal trade of this country, most valuable work.

The Foundry and Machine Tools

But, valuable as that work had been, and immensely important as were the foundations which the foundrymen had laid—because, after all, on the craft and skill of the foundrymen depended in large measure the ultimate efficiency of the machine finally produced—their work from the point of view of strengthening our position in the world of industry had been largely enhanced by the introduction of the protective system in this country. He was interested in the machine tool trade; and all who were intimately associated with industry would agree that there was nothing more interesting in modern industry than a highly developed and beautifully balanced complex machine tool. The ultimate beauty and efficiency of that machine tool depended in large measure upon the skill and craftsmanship of the foundrymen who produced the fundamental castings from which the tool was derived. During the last four years we had succeeded, because of our changed economic policy, in giving some more ample return to the skill of the original designer, to the original foundryman, and to the craftsmanship which built up the machine tool or any other instrument of production, in order to enable industry to carry on successfully, to employ the workpeople and to secure a fair share of the markets of the world. There had been a change in our economic policy by which it was laid down as a fundamental principle of British statesmanship that enterprise in this country should have equal opportunity at least with competition from outside. He had given the greater part of his life to the maintenance of the proposition that the protection of the home market of this country was the first essential to our national prosperity; and the lesson of the last four years, showing our increasing competitive power and the immense expansion of opportunity within the country itself, was convincing evidence of the fundamental rectitude of that proposition.

Commenting further upon the extent to which the foundrymen were co-operating with other bodies, which was a source of delight, he said they had introduced into their highly-developed craft all the appliances which science could provide; they were in touch with schools and colleges and kindred institutions in which the application of science to the practical side of industry was made part of their educational life; and it was also interesting to note that they were in touch, throughout the British Empire, with the various institutions and bodies which were concerned for the development of scientific methods in every branch of their work. We were living in an age in which science was playing a greater part than ever before in competitive industry. If one attended, as so many of the members of the Institute did attend, international conferences in the various branches of the engineering or chemical or any other trades with which the prosperity of this country was so closely identified, one would appreciate the intensive efforts that were being made by foreign Governments—it was interesting to note what Russia had been trying to do in recent times to carry out large schemes of systematic research to improve the various industries it was trying to extend within the limits of a somewhat scattered and disorganised community.

Educational Activities

The Institute of British Foundrymen, at its annual conference in 1914, had really laid on a substantial foundation the beginnings of what might be called the production of cheap and accurate castings as an essential part of organised industrial production in this country. There was always a starting point in industrial organisation to which one might look back, or a point at which a definite constructive change had been made in the policy and purpose of an organisation; and the Institute of British Foundrymen could date back its real constructive influence on industrial organisation to 1914. As one who had been connected with organisations of various kinds for more than 30 years he was interested to observe the carefully considered way in which the Institute had provided sub-committees to deal with specific sections of the industry in order to concentrate examination and research and get the best out of each particular field of investigation. He also congratulated the Institute on the arrangements it had made with the City & Guilds of London Institute so as to introduce the principle of examination on a practical, sound and inspiring footing—not the casual and perfunctory sort of examination to which we were accustomed in academic life in this country. Having been an examiner in years gone by, Mr. Hannon confessed that he had formed a low estimate of a certain type of examination; but the link established between the foundry craft and the City & Guilds of London Institute—which latter he had known so well when a student at the Imperial College of Science many years ago—stood entirely to the credit of the Institute of British Foundrymen. That link resulted in giving a hallmark to apprentices entering this admirable craft, which lay at the very root of industrial construction. There was also the contact which had been established with local technical institutions; and as one closely connected with the city of Birmingham he was particularly happy to observe that from year to year the technical schools, particularly bodies such as the Central Technical College in Birmingham, were playing a great part, without interfering in the slightest degree with the interests of either manufacturers or workpeople, in stimulating research, encouraging the examination of new methods, presenting examples of new processes, new designs and new methods of computing costs and a whole series of matters of interest to industry. The contact established with the Dominions and foreign countries provided further proof that the Institute was indeed a live body, playing a very important part as a basic element in the structure of industry.

Finally, as one who represented a very great industrial community, Mr. Hannon expressed his pride in being associated with the work the Institute was carrying on with so much efficiency and success, and he wished it prosperity in the future.

Institute Losses

MR. J. E. HURST (President of the Institute), who was received with prolonged applause, took the opportunity first to congratulate the Branch on the return of its President to active duty. He recalled also that at the recent luncheon of the British Cast Iron Research Association Mr. Hannon had said that he had been incontinently sacked; one was glad that his "boss" had taken him on again—and at the same piecework rates.

Responding to the toast to the Institute, he said he liked the thought that he represented not only the officers and members of the London Branch, but the whole of the administrative officers and members of the Institute throughout the country and throughout the world.

The very reference to the fact that the membership extended throughout the world reminded him of the loss the Institute had sustained a few weeks ago by the death of Mr. Finch, its

founder. Only thirty-three years had elapsed since Mr. Finch had gathered together a little band of individuals in Birmingham and had founded the Institute, a body which had grown into one of the leading metallurgical institutes in the world and had been honoured by the Privy Council by the grant of a Royal Charter. The leader writer of THE FOUNDRY TRADE JOURNAL had described him as a modest pioneer; one hardly believed Mr. Finch had contemplated that the Institute would have grown to its present magnitude.

As though it were designed to emphasise this apt description of the founder of the Institute, the hand of the reaper had taken away one of the honorary members, the late Rt. Hon. Arthur Henderson, himself a foundryman and one who had valued his honorary membership of the Institute amongst his proudest possessions. It was a matter for pride that one of the leading statesmen of our time should have been a foundryman and should have so valued the Institute.

Co-operation in Education

The developments in foundry metallurgy during the last few years, continued Mr. Hurst, had been such as to astonish metallurgists. It was also true to say that the Institute had played a leading part in those developments. Further, the result of the Institute's association with the City and Guilds of London Institute, the Institution of Mechanical Engineers, and other examining bodies, and the founding of foundry examinations had been to establish foundry schools in various parts of the country, culminating in the establishment of the British Foundry School in Birmingham and of the Foundry Degree Course at Sheffield University. In addition, the Institute had been ceaseless in its efforts to encourage individual research in matters relating to foundry practice. It offered individual investigators the facility to publish the results of their investigations for the benefit of the foundry industry at large. One need not enlarge upon the work of the Institute's Technical Committee and its sub-committees.

Urgent Need for Extensions

It would be agreed that the developments in foundry metallurgy in recent years had been of necessity accompanied by increased activity within the Institute. Already those developments and the increased activity were making increased demands upon the time of the Institute's administrators and upon its financial resources. Its volume of Proceedings, for example, was becoming all too small to accommodate the Papers selected by the Literary Committee for publication. The work of the Technical Committee, under the able guidance of its convenor, Mr. J. W. Gardom, was beginning to present a problem to the Literary Committee in finding ways and means to publish it. It must be quite clear to those who had the best interests of the Institute at heart that, if it were to continue to act in accordance with the objects as set out in the Royal Charter under present-day conditions, continued careful and earnest attention must be given to the future policy. With this in mind, and with the permission of the Council, he had arranged to have more frequent meetings of the Executive Committee; and he felt sure all thinking members would agree that the two most important points of future policy they could consider with a view to making recommendations to the General Council were the extension of the activities of the Institute and the improvement of its finances. In his opinion, extension of the activities of the Institute must ensure continued support and interest in its work on the part of all connected with the foundry industry; improvement in revenue would make it possible for the Institute to carry still further its service to the industry and to continue the objects of its modest founder, Mr. Finch.

An Overworked Staff

The President also took the opportunity to comment upon the overwhelming work with which the staff of the Institute was faced. The secretary and his small nucleus of staff were faced with an overwhelming task in dealing with the work of the Technical Committee and the various standing committees, in addition to carrying on the ordinary work of the Institute. He also acknowledged the enormous amount of voluntary work done on behalf of the Institute, by the standing committees, the Technical Committee, the local Branch-Secretaries and the local Councils. All the individuals concerned gave their service freely and without stint. An outstanding official to whom the President referred particularly was Mr. W. B. Lake, the Hon. Treasurer. The least the Institute could do, he said, was to shape its policy and organisation to secure ample recognition of all this voluntary work; there was no technical institute throughout the world that was able to rely on so much voluntary service.

Finally, the President said he had read somewhere that associations, of whatever kind, followed a sort of general plan of evolution. There was in the beginning a birth, followed by a more or less prolonged rise to maturity, which, in turn, was followed by decline. Whether or not one envisaged such a plan of evolution depended upon the particular brand of philosophy that one adhered to; but he personally felt quite sure that that plan was all wrong so far as the Institute was concerned. He preferred the view that associations in general, and the Institute of British Foundrymen in particular, could confound the evolutionist by declining to decline; by the influx of new blood it could continue its condition of maturing for ever.

The London Branch

MR. BARRINGTON HOOPER, C.B.E. (Managing Director, THE FOUNDRY TRADE JOURNAL), proposed the health of the London Branch of the Institute—though it seemed to him to be rather akin to taking coals to Newcastle to propose the health of so robust and healthy a body. He understood that it was the second largest Branch of the Institute, and had the distinction, in its flourishing condition, of contributing more to the central exchequer than any other Branch. About the year 1921 the Branch was reorganised and placed on its present sound basis by such worthy members as Mr. Wesley Lambert, Mr. V. C. Faulkner, Mr. H. O. Slater, Mr. A. R. Bartlett, Mr. G. C. Pierce and Mr. Cleaver, all of whom were still prominent in Branch affairs. One must not forget also the valuable help rendered at that time by the late and revered friend of the Branch, and Mr. Barrington Hooper's colleague, Col. Cheesewright; one was pleased to welcome his son-in-law, Mr. Dewar, at this Branch annual dinner.

The Branch, he continued, had been in the forefront, creating new activities. It was due to the efforts of the Branch that the Institute's Technical Committee, which had such ramifications, was formed. Recently it had organised also the system of holding joint meetings with other Branches, a phase of the Institute's work which, fortunately, was spreading. The Branch was also proud of having provided three national Presidents—not counting "Jimmy" Hurst, who was at one time a distinguished member of this Branch.

Coupling with the toast the name of the Branch-President, he said that Mr. Blackwell had joined the Institute in 1927, and during the time he could spare from the Institute's work he served as manager of the Davis Gas Stove Company, of Luton, which had one of the premier mechanised foundries in Great Britain, melting something like 350 tons of metal per week. Mr. Blackwell was tremendously interested in welfare work, was prominently associated with most of the official bodies organised to take care of industrial welfare, and his influence had an important effect. It had been a source of great regret to the members of the Branch that recently he had been far from well, no doubt due in large measure to the enormous amount of work he was always doing in the interests of those a little less fortunate than the majority. It was pleasing to know that his doctor had given him an excellent bill of health.

Having expressed his personal pleasure that the Institute's distinguished friend, Mr. "Pat" Hannon, was present at the dinner, MR. BARRINGTON HOOPER regaled the company with some apt stories of the kind which render his after-dinner speeches so attractive, his concluding thought being that suggested by a schoolboy's essay, that "in the United States of America they put people to death by elocution."

MR. F. O. BLACKWELL (President of the Branch), responding, said that all the members were justifiably proud of the London Branch, with its increasing activities and membership. Its prestige, he said, was important; our brethren from the Empire overseas and our friends from America and other countries who visited this country came to London first, and they knew that if they made themselves known to the London Branch, they could promptly make contact with any activities in any part of the country they were desirous of visiting.

In a tribute to Mr. Barrington Hooper, as managing director of THE FOUNDRY TRADE JOURNAL, and one who was in contact with many branches of industry, he said that, when one saw the journals he controlled, one was filled with admiration for the avidity with which they followed so closely on the heels of new discoveries and improved methods.

MR. V. DELPORT proposed "The Visitors." In a tribute to Mr. Hannon, he said the Branch had been so certain that he would be re-elected to Parliament at the last general election that on the notices concerning the dinner, which notices were prepared before the election, the letters "M.P." had been included after his name. Indeed, he had been re-elected by a very large majority for the Moseley Division of Birmingham. He held the distinction of being one of those Members who, in the grey dawn, arrived at Westminster in order to secure a good seat in the House. The Branch was indebted to him for his interesting speech and his masterly delivery.

Another guest was Mr. Barrington Hooper, a great friend of the Institute, and more particularly of the London Branch. He was also the host of the Branch Council, in that he had kindly placed his offices at the disposal of the Branch Council for the purposes of its meetings, a kindness which was highly appreciated.

In a tribute to the genial Mr. Hurst, President of the Institute, Mr. Delport emphasised that, thanks to him, a considerable advance had been made in our knowledge of cast iron, and his reputation in that connection was world-wide. His Papers had been published in pretty well all countries in the world which produced castings, and his books were known not only in Europe but in the United States also. The members of the Branch were indebted to him for his encouraging remarks.

The Institute of Metals was represented by Dr. C. J. Smithells, the chairman of the London Section of that body. That Section would be the hosts of the London Branch of the Institute of British Foundrymen at a joint meeting to be held during the following week—an annual joint meeting. Dr. Smithells was very well known for some very important work he had done in investigating various impurities in metal and the effects of gases in metal.

Another friend was Mr. K. W. Bridges, so largely responsible for the success of the Engineering and Shipping Exhibition, in conjunction with which the Foundry Trades Exhibition had been held this year. The members of the Branch were always pleased to welcome him.

(*Concluded on page* 444.)

Foundry Coke*

By W. E. MORDECAI, B.Sc., A.M.I.Chem.E.

In presenting a Paper to a mixed body, consisting of makers and users of coke, the outstanding thought must be that of service to the consumer. Coke manufacturers realise that the varieties of practice in foundry work demand differences in coke qualities. During the last ten years, manufacturers, in attempting to satisfy the ever-increasing stringency of the users' specifications, have improved their products by research, experiment and the erection of new plant. At the same time, it is felt that insufficient advantage is taken of the benefit that can accrue from a mutual interchange of ideas in joint meetings of this kind. It occurs to the author that, whereas foundrymen are acquainted with the general properties of coke, there may be properties not so well known to them. On the other hand, it is probable that the average cokemaker has a vague knowledge of founding.

Chemical and Physical Properties

Not many years ago, coke was assessed primarily on the basis of a statement of its chemical content of "fixed carbon," ash and sulphur. To-day it is recognised that not only is the total amount of chemical impurity of significance, but also the nature and constitution of that impurity are of vital moment; and, although the influences of diverse physical properties of coke have gradually assumed equal importance, it is not yet fully appreciated to what extent chemical and physical properties are interdependent. Cokes of highest repute owe their superiority to especially physical properties and to a high degree of chemical purity, and also to some essential and peculiar interrelation of all these properties.

Carbon

The foundryman must have coke of high carbon content, because this is related to calorific value and calorific intensity. It is usual to indicate "fixed carbon" as that left after deduction of the main impurities, such as moisture, ash and sulphur. It is known that two cokes having equal "fixed carbon" of, say, 90 per cent. will give different performances, especially in the matter of carbon "pick-up," in one and the same cupola under similar conditions of use. It is natural to conclude that "fixed carbon" may vary in constitution. It has been contended[1] that much of the carbon is graphitic, and that some exists as complex carbon compounds. More recently Blayden and Riley[2], in their investigations into the nature of the "carbon" of which coke is mainly composed, have indicated the superiority of cokes having a high graphite content. It is known that the amount of graphite in coke is proportional to the temperature of carbonisation, and that high graphite content is conducive to high cupola temperature. Unfortunately, high carbonising temperatures usually yield small coke, although this difficulty may be overcome by blending and oven design.

The opinion of foundrymen is sought as to the comparative influences of "graphite" and impure forms of carbon in coke upon the carbon "pick-up." If there are differences, then in course of time buyers may specify the kind or quality of carbon desirable in coke. Such a condition can only be met in carbonisation by selection of seam constituents and by a more fundamental knowledge of the controlling factors. Nature, rank or parentage of coal present inherent difficulties, but such inherited tendencies can be modified by environmental control.

It is known that, in the cupola, carbon "pick-up" is related to the rate of melting, nature of metal, temperature of melting, extent of coke surface, size, cubic capacity, blast, design of cupola, coke consumption. Moreover, it is governed[3] by (*a*) regularity of feeding coke, (*b*) weight or quantity of coke charged for bed, (*c*) time of contact, and that it can be reduced by excessive air at high pressure. Carbon "pick-up" must also be related to the method and rate of carbonising and to the conjoint effects of porosity and reactivity. In view of such a large array of factors, it would seem to be a hopeless task for the carboniser to satisfy each and every demand put upon him by the founder; the solution of such difficulties can be aided by more intimate discussions between maker and user.

Sulphur in Coke

Sulphur may exist in coke in association with iron, lime and alkalis as sulphide or sulphate, and also in solid solution or in a state of adsorption with the carbon complex.[4] It is believed in some quarters that the sulphur associated with iron is the most deleterious form. The extent of sulphur "pick-up" by metal depends on (*a*) total amount of sulphur in coke, (*b*) the form in which sulphur exists in coke, (*c*) nature of the coke ash, (*d*) sulphur in metal charged. It would appear reasonable to expect that, other things being equal, low-sulphur irons take up more sulphur than high-sulphur irons. It is also claimed[5] that high-silicon irons are less likely to pick up sulphur than low-silicon irons, because of the formation of volatile silicon sulphide.

Sulphur "pick-up" can be influenced by (*a*) ferrous oxide and lime in slag, (*b*) depth of melting zone,[6] (*c*) control of manganese, (*d*) temperature of metal and slag.[7] It can be minimised by (*a*) the use of sodium carbonate or additional limestone. The use of carbonate in the cupola, as distinct from in the ladle, is said to minimise "pick-up," not so much by removal as by prevention, and that desulphurisation can actually be effected in the cupola by control of calcium oxide in slag,[8] (*b*) control of factors giving superheated metal.[9]

As it would seem that 30 per cent. to 50 per cent. of the sulphur is transferred to the metal, a fuller knowledge of founding conditions and of the influence of the forms of sulphur existing in the coke would assist carbonisers in the selection and blending of seams of coal to give foundries exactly what they need.

Ash Content

Ash.—Foundrymen usually specify a maximum ash content. The following observations are offered upon a subject full of difficulties. (*a*) The percentage ash statement can be varied by the conditions of carrying out laboratory analysis.[10] (*b*) Ash content may be lowered to such an extent as to reduce crushing strength, but this is not a common experience; or certain coals can be cleaned too low and by selective removal of silica lower the ash fusibility. (*c*) The chemical constitution of the ash will affect the character of the slag, or may influence sulphur "pick-up," *e.g.*, iron in ash; while slag composition determines melting point and viscosity of slag[11] as well as the physical properties of the iron.[12] (*d*) the physical condition of the ash-forming constituents can affect the strength and tendency to fissuring in the coke, *e.g.*, degree of fineness of coal. (*e*) The fusibility of ash in large pieces of coke may be different from that of a ground sample in the laboratory. (*f*) The properties of the constituents of ash as made in the laboratory may not necessarily reflect the properties of the ash-yielding constituents as they exist in the coke. (*g*) Sulphur in melt may increase with ash in fuel as it does in blast-furnace practice.[13] Exceptionally low phosphorus is not usually demanded, and its influence in the case of special metals is conceivably determined by the form in which it exists. While there is a fair amount of evidence on its distribution and effect in blast-furnace practice, cokemakers are not so sure of what happens to it in cupola work. It is certain that in some foundries it is negligible, bearing in mind the much smaller ratio of coke to metal in cupolas than in blast furnaces.

Size of Foundry Coke

Size of foundry coke has always been a source of trouble. In general, large coke is demanded, although some works prefer average to large or mixed sizes. There are instances of large cupolas having changed from large to small coke without detriment. Coke manufacturers welcome information on the effect of size, because of the apparent diversity of opinion among foundrymen. Possibly this is in some measure due to the fact that what some people call big coke, others call small coke. On the one hand, we are told that hard, large-sized coke is desirable,[14] and, on the other, that lump size is of subordinate importance.[15] It is true, of course, that size is related to resistance to fracture or shattering, and it is important to note that a shatter index statement loses much of its value unless accompanied by a screening analysis of the coke (unshattered). A grading, 4 in. by 6 in., may be more acceptable than a 3-in. by 10-in. At the same time, a 6-in. by 10-in. grading may fetch a higher price, although its shatter index may be less than for other gradings. On the other hand, a 2-in. by 4-in. size may be quite suitable for small cupolas, and this grading gives a higher shatter index than a large grading of the same coke. It is probable that the shatter test does not reproduce the conditions of impact existing in the cupola any more than it reproduces the condition of attrition in the blast furnace. At the same time, the insistence of many foundries on uniformity of coke size is puzzling to a cokemaker when he thinks of the lack of size uniformity in other material fed into the cupola.

Density

Many foundrymen do not use this term to mean specific gravity or bulk density, but as an indication of porosity conditions reflected by an open or closed texture or by large or small pores. A high percentage porosity is considered desirable provided pore size is not excessive; and, although there may not be unanimity of opinion on this point, it is noteworthy that beehive cokes have high porosities, and crucible-steel melters associate this with high calorific intensity. On the other hand, it is known that first-class by-product cokes can give performances equal to beehive cokes. There can be no question that the nature of the cell structure has a bearing upon coke strength, combustibility and capacity to absorb water, and it is significant that some of the best cokes have a low percentage of closed pores. The elimination of such closed voids can be effected by very fine grinding.[16] In addition, there are indications that fairly low apparent specific gravity and high true specific gravity are found in the best cokes. How far porosity has been improved by the adoption of uncompressed in place of compressed charges is difficult to estimate, but there is abundance of data to justify the change from the effect on fissuring and shatter index; moreover, it must be noted that the coal charges in beehives lie very lightly. Coke having small-sized pores will absorb less water during quenching and exposure to weather than coke having large-sized pores. While being unaware of all that bulk density may mean in foundry practice, the author found that, in the examination

* A Paper read at a joint meeting of the Institute of British Foundrymen and the Coke Oven Managers' Association, Newcastle-upon-Tyne, Mr. J. Smith presiding.

of ten cokes, the weight per cubic foot increased mainly through moisture and ash; mechanically weak cokes absorb more moisture than strong ones; small pieces of coke become water-logged easier than large pieces.

Reactivity

Reactivity to carbon dioxide diminishes with increase of graphitic carbon in coke, and with increase of carbonising temperature. The importance of coal constitution is realised from the fact that certain South Wales coals, when coked at 800 deg. C., yield as low reactivities as Durhams coked at 900 deg. C. The reactions of coke to carbon dioxide and oxygen in the cupola appear to need further elucidation, especially when two types of cupola designed to work on apparently different combustion principles give equally good results, and when oxidation and reduction occur simultaneously over a relatively narrow sectional area.[17]

It is known that reactivity to carbon dioxide may be varied by catalytic or inhibiting factors, and that under particular conditions it may be insignificant at very high temperatures. Moreover, cokes having high oxidation values in chromic acid have high critical air blasts when tested by such methods as are practised by the Northern Coke Research Committee. This suggests a reason for coke users failing to obtain maximum possible temperatures from close-grained cokes, in that the blast is not suitably adjusted. Again, experience shows that low reactivities to carbon dioxide are associated with high shatter index, large coke, low ash, low reducible iron in coke; and, further, that low reactive cokes can yield high fuel-bed temperatures; beehive cokes usually have low reactivities; low reactivity is associated with low fuel consumption and high apparent porosity. But it is not suggested that reactivity is low on account of these factors. Coke research organisations have spent much time on the study of reactivity, and the opinion of foundrymen is sought as to whether reactivity is of importance or not. It has been stated[16] that there is little relation between reactivity and exit gas analyses on the cupola, and that cokes having otherwise similar properties and compositions give similar results. Again, it has been suggested that reactivity is determined more by size than by the amount of graphite crystals in coke.

While the cokemaker is anxious to give a product of consistently high value, he is aware of instances and circumstances in which coke is not allowed to give of its best in service. For instance, it is well known that in many cupolas there is no measurement of blast pressure, temperature, humidity or volume. Measurement and control of air are essential to the successful use of coke in obtaining high temperatures. The design of cupolas in the matter of air admission has always been a subject of technical discussion, yet few cupolas have a recording or regulating instrument for air. It has been suggested that best results are got by using a standard air blast approximately 15 per cent. in excess of the theoretical needed to burn average coke.[19] This, of course, involves the idea of a standard coke. Apart from the incidence of atmospheric factors causing variations in moisture, a standard coke is easily obtained when the source is a single one, and should not be difficult to arrange even when supplies are from various sources. As the main object of this Paper is to stimulate a free discussion of the problems arising out of the use, and occasional abuse, of coke, it seems desirable to supplement the above observations with a few questions arising in the mind of a cokemaker:—

(*a*) What relationship has diameter of cupola to size of coke?

(*b*) How does the repair condition of the refractory lining of a cupola affect coke consumption and temperature of metal?

(*c*) Why does beehive coke continue to be favoured in some quarters, especially among pot melters, even though its ash content may be very much higher than in a by-product coke made from the same coal source?

(*d*) What influence, if any, has coke quality upon such physical properties of the metal as tensile, shrinkage, fluidity?

(*e*) Why do some foundrymen weigh all the material entering and leaving the cupola and others do not?

Certain it is that, given a deeper knowledge of the requirements of the foundryman, cokemakers are now able, by blending and by adjustment of carbonising conditions, to supply products having physical and chemical properties conforming to the most stringent specifications.

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DISCUSSION

MR. C. GRESTY, who opened the discussion, commented upon the fact that a single truck of coke could be responsible for the destiny of hundreds of pounds worth of castings, and he asked the lecturer how a cokemaker would evaluate his product. He sought information as to the tests that could be made, other than trying the coke in the cupola. In referring to Question C in the Paper, he asked, "What is the real difference—does it lie in the carbon content?"

He further commented upon the presence of sulphur in iron, and asserted that it is not giving so much trouble as formerly, and it was now realised that great advantages can be gained from high sulphur, providing it is properly balanced with manganese.

MR. MORDECAI, in his reply, stated that cokemakers suggest certain physical and chemical tests for assessing coke values, but it was difficult to say they were all applicable in every case, because of the diversity of specifications put forward by foundrymen. Some founders ask for coke having sulphur of the order of 0.5 to 0.6 per cent. and ash 5 to 6 per cent., and shatter index of 92 to 94. Other founders do not ask for such specifications; neither do they test the coke, but complain when the coke apparently does not do the work required of it.

He remarked that great reliance was often placed on size of coke, and recalled an instance of a founder being insistent upon large coke and who changed to small coke with apparently equally good results.

Dealing with Mr. Gresty's question on the differences between beehive and by-product coke, he said there was merely a prejudice in some quarters in favour of beehive. Generally, it has been proved that by-product coke could do anything that was done by beehive.

He was glad to learn that sulphur may not be such a bogey, although he was aware that in many cases the stringency of specification had increased. On the other hand, it had been proved that coke containing, say, 0.9 per cent. sulphur may give up less sulphur to metal than one containing, say, 0.6 per cent. if the sulphur existed in suitable form.

MR. J. N. SIMM, in disclaiming any immediate contact with the manufacture of castings, nevertheless expressed interest in the hardness of coke, with which he was directly concerned. He asserted that beehive coke can be ground more finely than patent-oven coke, and for use with the manufacture of blackings he favoured it on that account. In other words, the harder the coke, the more easily and the finer could it be ground.

MR. MORDECAI replied to the effect that there was no real agreement as to what was meant by "hardness" amongst foundrymen. It appeared to him that, so far as the cupola was concerned, it was impact value which was of paramount importance, as coke must withstand the shock of lumps of pig being dropped on it. He agreed, however, with Mr. Simm that cokes could be judged by the hardness experienced during the grinding of a sample into a fine state.

Woolliness in Coke

MR. J. W. FRIER related an experience when he had trouble with coke some years ago. He discovered that inside the coke there appeared a black woolly substance. Upon complaining to the suppliers, a representative was sent to examine this, and after smelling and tasting it, he expressed the opinion that the coke was perfectly sound. Mr. Frier, however, had never been able to discover exactly what this substance was.

The LECTURER stated that he had never come across that kind of thing, but he quite thought that Mr. Frier's experience was an excellent answer to Mr. Gresty's question on testing, and perhaps it could be adopted by cokemakers in the future. He thought the woolly substance was probably composed of fine strings of carbon which are found in beehive coke.

At this point PROF. H. LOUIS intervened, and stated that he attributed this to a bad type of coal, combined with a poor system of carbonising.

MR. R. O. PATTERSON (Past-President of the Institute) made reference to Question A in the lecturer's Paper, *i.e.*, "What relationship has the diameter of the cupola to the size of coke?" He stated that the smaller the cupola, undoubtedly the smaller the size of coke necessary. For a small cupola, 20 in. by 24 in. dia., 2- to 3-in. nuts could be used with success, and he was definitely of the opinion that enormous pieces of beehive coke for the larger cupolas were quite unnecessary.

Within his experience he had obtained better results by using patent-oven coke, and he felt that foundrymen would not change from beehive simply because they did not wish to. He further felt that no two foundrymen thought alike on this rather difficult question.

MR. MORDECAI agreed with Mr. Patterson's contention and said that the same thing applied to cokemakers. He commented upon moisture in coal, saying that some people contend that if moisture in the coal is reduced it will improve the coke, whilst others will not accept this as being the case.

MR. W. SCOTT, in referring to Question B, said he would like to offer his answers to the question. He stated that if the lining is not repaired correctly, then the cupola will not work in its normal state. Holes in linings, due to faulty repairs, may cause hanging-up of the charges, resulting in cold or oxidised metal.

Referring to Question D on the influence, if any, that coke has upon the physical properties of metal, he felt that the coke can affect those properties very materially, as metals are now melted to a fine degree of exactitude. Coke has a great influence on the size of graphite which is obtained in the final metal. Also, if the coke broke easily he found that it had an effect on shrinkage and on the oxidation of the metal which, of course, would increase the shrinkage very materially.

He then referred to the question of beehive coke, and asked if there was not some inherent quality claimed for this, just as the foundrymen claimed a preference for cold-blast iron. He said it was possible to obtain hot- and cold-blast iron of the same analyses, but the inexplicable fact

remained that foundrymen still favoured the former.

Concerning Question E, he stated that foundrymen making important castings usually weigh all their materials when charging, and that unless this practice was followed throughout, they could not expect satisfactory results. He further felt that foundrymen who did not adopt this practice must be very much in the minority.

PROF. H. LOUIS, in commenting upon the Paper, said he considered more importance attached to analysing iron than to analysing coke, and throughout the whole Paper he saw no mention of scrap. He said he had experience both as a coke-oven manager and an ironfoundry manager, and this question of analysing the iron seemed to him to be most important. Concerning the size of coke, he felt that small coke should be used in the cupola, excepting as bed coke, when large sizes should be used. He also made reference to the sand that clings to the outside of the pig, and stated that this was the most important part of the slag-producing element. He saw no mention of this in the Paper, and asked the lecturer's views on this question.

Continuing, he remarked that in those days coke that contained more than 5 per cent. of ash would be considered inferior. With regard to the temperature of the cupola, his trouble had been not to obtain a certain temperature, but to keep the temperature down, and he knew it was the practice to keep molten iron in the ladle until it had cooled to the desired temperature.

MR. MORDECAI, in thanking Prof. Louis for his comments, said he had purposely refrained from mentioning scrap or sand on pig-iron, as he felt it was hardly prudent, if fair, for a coke-maker to question the founder as to the character of material other than coke fed into the cupola.

In the matter of ash content it was probable that in Prof. Louis' early days there were coking coals having very low ash content. To-day a few cokes were made containing ash of the order of 5 per cent. Coals can be cleaned to within 0.5 per cent. of their natural ash content, and as the inherent ashes of most British coals were 2 to 2½ per cent. it should not be difficult to make coke containing 5 per cent. ash.

MR. J. SMITH (Branch-President) said he felt that no matter what quality of coke is used, it is up to the foundryman to see that the cupola is worked consistently, otherwise trouble will ensue. Concerning beehive coke, he felt it was no different from any other, and provided the foundryman could keep his cupola going, he should obtain quite good results with either beehive or patent-oven coke.

MR. MYERS, of the Coke Oven Managers' Association, said that that body had nothing to do with the commercial side of the organisation, but they existed to further the technical progress of the industry, and he, with others, had attended the joint meeting in order to learn something from the foundrymen.

Coke such as that referred to by Prof. Louis was made in County Durham probably for a hundred years, when coal seams were available which produced coke containing 7 per cent. of impurity. Industry is now dependent on other seams of coal which have to be mechanically cleaned.

He had hoped to learn from users of by-product coke and beehive coke what difference there was between the two. On occasions he had been compelled to use coke containing 20 per cent. ash, but it was impossible to make castings quite successfully with this.

Questions had been asked concerning the difference between beehive and by-product coke—this is in the carbon. Beehive coke is made in a heap inside a closed vessel, whereas by-product coke is made by heating the coal in a closed vessel, but in a different way. In the by-product oven, the coke is carbonised by heat applied from outside, whereas beehive coke has the heat applied from inside. There can only be a difference in the carbon that is left behind. There was no truth in the statement that goodness is removed from coke by virtue of the by-products extracted.

There was a mass of conflicting evidence on the relative merits of various cokes, and he felt, with others, that no two persons thought alike on this subject, combined with that of the metal melted. The object of these joint meetings was to crystallise a few facts from this mass of evidence, so that the coke manufacturers might make a fuel that would be satisfactory to the user as well as profitable to themselves.

MR. R. O. PATTERSON, in associating himself with Mr. Myers' remarks, related an experience he had had during the general strike of 1926. He stated that he had then been compelled to use a substitute for coke in the nature of a quantity of electrode ends, and which were made from dehydrated anthracite. They were as hard as whinstone, and the porosity would possibly be nil, yet the metal melted was hotter and very satisfactory castings were obtained.

PROF. H. L. RILEY said that it was possible to determine scientifically and accurately the properties of coke. He felt that there was no need to change directly from one coke to another, but very good results could be obtained by making a gradual change. This could be achieved by mixing small quantities of a new quality, observing the results, and gradually increasing the quantities, and he commended this suggestion to foundrymen.

In conclusion, it was felt by all members present that joint meetings of this nature could prove to be very profitable to both the coke-makers and the foundrymen, but on another occasion it would be as well to come prepared with questions which could be mutually discussed and thrashed out to the benefit of both bodies.

A vote of thanks was passed to the lecturer for his excellent address.

Hard-Facing

MATERIALS USED

The process of hard-facing, writes MR. R. E. BROWN in a recent issue of "Metal Progress," consists in welding a coating of a wear-resisting alloy $\frac{1}{16}$ in. to $\frac{1}{4}$ in. thick to the wearing surfaces of a metal part. High-quality materials for this purpose should possess the following properties:—(*a*) Inherent hardness; (*b*) "red hardness," or ability to retain initial hardness up to red heat and to be unaffected after cooling slowly from red heat; (*c*) resistance to abrasion during use; (*d*) resistance to high-temperature oxidation during its application; (*e*) melting point slightly lower than steel, the usual base metal; (*f*) coefficient of expansion close to that of the base metal; (*g*) easy application by ordinary technique; (*h*) ability of being applied with minimum effect on the structure of the base metal.

The alloys suitable may be roughly classified as follow:—

GROUP 1.—Alloys of low cost per lb., practically all of which are merely high-carbon steel or hard cast irons with or without a little alloy. They are generally rather brittle and adhere rather poorly. They have had very little success in severe duty and are limited to applications where a hard steel or iron part would be satisfactory.

GROUP 2.—Metals that are essentially austenitic-alloy steels containing varying amounts of chromium, tungsten, manganese, or silicon, the total of all usually below 20 per cent. Such alloys have considerably greater wear resistance than any ordinary carbon steel, especially if they possess properties somewhat similar to 13 per cent. cast manganese steel. They are intermediate in unit cost. They make an excellent filler rod for rebuilding badly-worn parts where service involves considerable heavy impact rather than scour. As they are usually quite tough and ductile, they serve well as a building-up material over which is to be placed a harder surface.

GROUP 3.—Metals that contain more than 20 per cent. and as much as 50 per cent. of one or more of the elements chromium, tungsten, manganese, silicon, cobalt, nickel, and carbon. This group includes the first true hard-facing metals, in the sense of materials which do not need to be cold-worked to induce hardness (like most of those of Group 2) but whose hardness is intrinsic.

GROUP 4.—This class consists of a group of non-ferrous cobalt-chromium-tungsten alloys of which Haynes' stellite is the exclusive representative. The iron content is negligible. Several different grades of the alloys are all highly resistant to abrasive wear but vary in strength and toughness. In this material cobalt is the base of the alloy, whereas iron is the base of all alloys in preceding groups. Its hardness is inherent and permanent in that it may not be altered by heat-treatments up to 1,650 deg. Fah.

GROUP 5.—Tungsten carbide and diamond substitutes make up this class, and these usually consist of 90 to 95 per cent. tungsten carbide with a ductile metallic binder. Tungsten carbides cannot be melted with the oxy-acetylene flame, so they are furnished in the form of small castings of various shapes, which are "wetted" and anchored in place on the surface of the part being hard-faced by means of another hard-facing metal frequently referred to as the tie-in rod. A tough, hard, tie-in metal is desirable so as to support the pieces firmly and prevent undermining the hard particle. Their largest use is on oil-well drilling tools, for boring through solid rock.

GROUP 6.—This sub-division comprises combinations of hard-facing alloy and crushed tungsten carbide, made in various forms.

Using the life of carbon steel as unity, the lives of other facings will be about as follow:—Hard steel, 1; Group 2, 1.5 to 2; Group 3, 2 to 4; Group 4, 3 to 10; Groups 5 and 6, 10 to 20.

It is believed that wear involves close rubbing contact, without lubrication, of tiny areas on two surfaces, and the molecules or particles at these contacting points become softened by the frictional heat and are torn away while in a relatively-soft condition. Hence the paramount importance of what may be known as "red hardness" in materials that are to resist wear, that is, the ability to retain their initial hardness up to red heat and to be unaffected after cooling slowly from red heat.

Instantaneous temperatures generated by friction are far higher than would be surmised. Surface temperatures of bodies sliding over one another under pressure often approach red heat, although there may be no visual evidence because the heat is rapidly dissipated into the body of the metals and the air. Thus, if the ends of two thermocouple wires be merely held against a rotating steel disc, a temperature of 1,500 deg. Fah. will be indicated, but to the eye there is no evidence of heat. Hence the ability of a hard-facing metal to resist wear must be determined under actual working conditions.

All alloys will soften as temperature is increased but the rate of softening varies. High-speed steel softens less rapidly than carbon steel, and the cobalt-chromium-tungsten alloys of Group 4 soften least of all. In fact, the iron content of a hard-facing alloy is inversely proportional to its comparative red hardness; with even a little the rate of softening increases and continues to do so in alloys successively higher and higher in iron. At temperatures above 1,100 deg. Fah. the cobalt-chromium-tungsten alloy Haynes' stellite has a higher hardness than any other known metallic alloy; in fact, it retains almost its original hardness up to temperatures of approximately 1,800 deg. Fah.

British Oxygen Centralise Sales Service Department

The word "service" has become so trite that it is almost meaningless unless firms making such a claim are prepared to substantiate their offers by a well-organised research department. In industry, the British Oxygen Company has gained a well-merited reputation for the real service it gives to clients, but it has been thought wise to assemble all the various branches of the sales service departments at the Cricklewood Works, in close proximity to the long-established research department. Most of these facilities have been available for many years, but their concentration at one centre, conveniently reached from all parts of London, and in new and enlarged premises, is the logical result of the company's constant efforts to improve the service facilities available to all concerned in the oxy-acetylene industry.

VIEW IN THE WELDING SCHOOL OF THE BRITISH OXYGEN COMPANY, LIMITED.

The new premises of the sales technical service department comprise demonstration shops, a welding- and cutting-instruction school, a lecture theatre, exhibition showroom and executive offices.

Functions of the Department

The functions of the sales technical service department provide a comprehensive before- and after-sales service. In the main demonstration shop there is a complete range of the company's oxygen-cutting machines, welding equipment, hand-cutters and equipment for leadburning, brazing, soldering, etc. In the smaller rooms adjoining are the metal-spraying and arc-welding demonstration shops.

Here interested parties may see a complete range of the company's equipment under actual working conditions, and can more easily decide the type of apparatus most suitable for their requirements. Again, a firm may wish to know if the oxy-actylene process, or metal spraying, etc., as the case may be, will be suitable for the particular class of work they have in hand, and in the demonstration shop practical tests can be made on the actual job, to ascertain its practicability and to obtain a measure of the cost which would be involved.

Welding School

The welding- and cutting-instruction school provides tuition for customers or their operators who have purchased equipment. But subsequent instruction can be given at any time, and it may happen that a firm using one or other of the processes takes on a different class of work and requires special instruction, which can be given in the school. The provision of a separate instruction school enables students to work without the distraction which might be occasioned by the work always in progress in the main demonstration shops.

The lecture theatre is equipped for the showing of cinema films or lantern slides. Monthly illustrated lectures will be given here, and are open to customers, members of the company's staff, or, in fact, to anyone interested in the industry. It may be mentioned that the company has its own cinematograph operator, and produces most of the technical films shown. These films are also available for loan to welding schools, technical societies, and so on. Another use for the lecture theatre is to amplify instruction given in the welding and cutting school, by the showing of slides or films relative to the particular work on which they are engaged.

A Permanent Exhibition

The Exhibition Showroom contains, as far as possible, a complete exhibit of all the company's products, but more particularly is it intended to show specimens of work which have been done by means of the various processes. This follows the basic principle behind the company's service, which is to show what can be done by means of welding, cutting, etc.; to improve the technique of those already using the processes; and also to assist in the development of new equipment and applications.

It is interesting to note that in the construction of these buildings all the heating radiators are of welded steel and all the pipes for the heating system have welded joints, connections and branches. All sanitary and water service piping is either of welded copper or, where lead is used, oxy-acetylene leadburning was adopted as the means of jointing. Many of the ceilings are constructed of steel panels, and in the lecture theatre and showroom the steel ceiling has been metal-sprayed with aluminium, obtaining a permanent decorative effect not possible by other means. Incidentally, the furniture in the lecture room and in the offices is of welded-steel construction.

Technical and Research Laboratories

In these laboratories all the company's raw materials and products, such as welding rods, fluxes, purifying materials, carbide, etc., are regularly tested in order to maintain the high standard required. Here also analyses are made, on behalf of customers, of special metals or other materials; in fact the technical and research department is responsible for all forms of chemical or metallurgical control and research in connection with the industry.

The most up-to-date apparatus has been installed. In the chemical laboratory there is, for instance, Sands apparatus for electro-chemical analysis, and the Hilger Steeloscope for determination by spectrum methods of small proportions of rarer elements in certain steels and alloys. Also other special apparatus specially suited to the nature of the work dealt with.

In the metallurgical laboratories the equipment includes high- and low-power photo-micrographic apparatus, binocular prism microscopes with photo attachment for macrographic work, also the Phillips' X-ray apparatus for the radiographic inspection of welds. A number of interesting views of X-rayed welds may be seen here.

VIEW IN ANOTHER SECTION OF THE WELDING SCHOOL.

The mechanical testing department includes 100-ton Avery, 30-ton Buckton testing machines and the Hounsfield Tensometer and the usual run of testing machines. Special attention is being given to the provision of facilities for the non-destructive testing of welds. The laboratories include a section devoted to the designing of special apparatus and the manufacture of experimental equipment.

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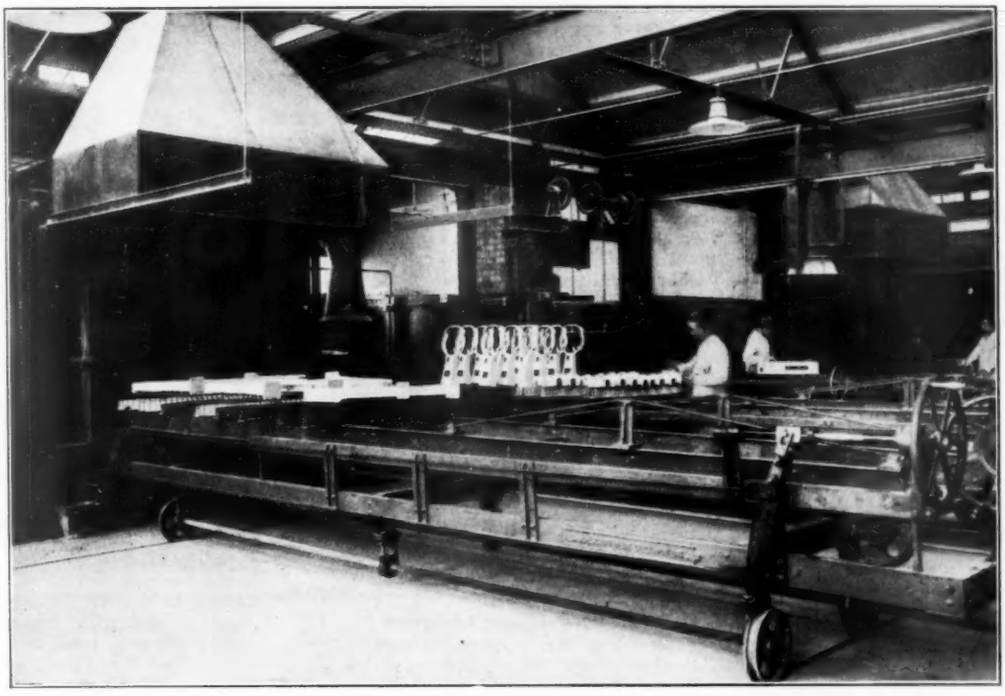

Illustration shows a battery of Muffle Furnaces, 12 ft. × 4 ft. 6in. wide, together with Speed Forks.

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Cupola Refractories

DISCUSSION AT SHEFFIELD

At a meeting of the Sheffield Branch of the Institute of British Foundrymen held recently, when members of the Refractories Association and the Ceramic Society attended by invitation, MR. W. J. REES dealt with points of his Paper on "Refractories in the Foundry," presented at the annual conference of the Institute.

Mr. Arthur Whiteley presided and the discussion was opened by MR. J. ROXBURGH (Senior Vice-President), who said he was greatly interested in the graph that Mr. Rees had shown depicting the percentages of silica and aluminia for firebrick manufacture. Naturally, those people who had to buy firebricks for cupola use must have something to guide them in their choice of suitable material.

Alumina Content of Firebricks

He was somewhat perplexed to hear Mr. Rees' statement that he had found in his experience that, for instance, a brick containing, say, only 12 per cent. alumina might have certain advantages over a brick containing 40 per cent. alumina. Thus far, as a buyer of firebricks for use in a cupola, he had always favoured a brick with an alumina content of 40 per cent. Another very interesting point had arisen from the fact that the 12 per cent. alumina brick was possessed of such properties that it developed a better glazing effect than the 40 per cent. alumina brick. Mr. Rees had referred to slag action, and he wondered if he had taken into consideration, too, the question of the property of the firebricks, forming the glaze upon the surface, this being more resistant to this action. Another interesting point was the question of refractoriness under load. Mr. Rees had shown them slides illustrating the effect of a load of 50 lbs. per sq. in., but later, when he referred to this aspect of the question, he (Mr. Roxburgh) was rather surprised to hear him mention a figure of about 30 to 40 lbs. per sq. in. (sometimes obtaining in a cupola), as a load of 50 lbs. per sq. in. would lower the refractoriness of a firebrick to the extent of 350 deg. C. He assumed, therefore, that with a load of, say, 30 to 40 lbs. per sq. in. one should look for a material reduction in the refractoriness. If the refractoriness of the brick, in the first place, was in the nature of 1,650 to 1,700 deg. C., the reduction ensuing from that pressure would be very considerable and might reduce the refractoriness to, say, 1,400 deg. C. He had felt also that the question of patching material was of considerable importance, as eventually it was the patching material which had to withstand the severe conditions, and he wondered if Mr. Rees would advocate for patching a material such as one could use as a ramming compound. Could that material which was suitable to be used as monolithic ramming material be used for patching a cupola lined with firebricks or would Mr. Rees suggest that that material should only be used as a patching material on a rammed lining?

Soda-Ash Bricks and Cupola Linings

In regard to the question of de-sulphurising, some people advocated the use of sodium-carbonate blocks in the cupola. They stated that primarily it reduced the sulphur content of the iron to an appreciable extent, but, at the same time they claimed that the sodium carbonate was helpful in improving the glaze on the bricks. He wondered if Mr. Rees could confirm this. Mr. Rees had also stressed the importance of the use of high-quality jointing cements. Naturally, they agreed with him. He was specially interested in Mr. Rees' remark that, despite the high price of those cements, it was advisable for the foundryman to make use of them. He would like more information on that point, for he supposed that in most places they simply used best-quality fireclay, which was comparatively cheap. When one inquired about the jointing cements, one was somewhat amazed to find that they were tremendously high in price. Therefore, he contended that they would have to have a greatly increased life compared with other ordinary jointing cements if they were to be worth while.

Forty Per Cent. Alumina Suggested

MR. REES observed that Mr. Roxburgh was correct in selecting a firebrick having a 40 per cent. alumina content. For normal modern cupola conditions a brick near the eutectic range did not give such good service, but there were many conditions where bricks in that range did give better service than a higher alumina brick. They found an example of that in boiler arches. There they had not only high temperatures, but a great deal of high-velocity hot gas carrying a quantity of dust. In these circumstances a brick containing 85 to 88 per cent. silica may last longer than a brick containing 40 to 45 per cent. alumina. The longer life was simply due to the fact that it developed a skin glaze. That was the type of service where he suggested the brick in the eutectic range was going to be better despite its apparent lower refractory value.

Mr. Roxburgh had referred to the important point of under-load refractoriness. It was, of course, due to the fact that in a cupola brick, and most other bricks, only one face of the brick was hot that they lasted at all. If they had the whole of a brick in a cupola hot, they would soon have no cupola. Normally, only one face of a brick was exposed to the higher temperature.

Fine Patching Advocated

In regard to Mr. Roxburgh's request for an expression of opinion on the respective merits of fine- and coarse-patching materials, he was rather tempted to step in where, perhaps, the foundryman would fear to tread, but he did think there was something to be said for the use of patching material which was not, at any rate, too coarse. He thought they could probably get a more adhesive and more permanent patch with finer material than with coarse. The advantage of the coarser material generally was that it would resist a much more rapid rise of temperature, but he thought it more than likely, if their patching material was "all matrix," so to speak, it would be more durable. They knew this was the case for "rammed" materials. In American practice, as he saw it, they used patching materials which were very much finer than those normally used here, and in some foundries in the North of England they normally used patching materials which were comparatively fine in texture.

In regard to the use of sodium carbonate in de-sulphurising and the claim that such a process did actually improve the durability of the bricks, he viewed the claims with some suspicion. If they were adding an active flux in the normal slag to the contents of the cupola, he would need a great deal of convincing that it would not have some destructive effect on the bricks. If they were using sodium carbonate, it was more important than ever to use a brick of the higher alumina type, with 38 to 40 per cent. of alumina. So far as jointing cements were concerned, he believed it best to use the higher qualities of these cements, providing that at the outset they insisted on getting bricks that could be very closely jointed. If they bought bricks at the outset that could be very closely jointed, they would use much less cement. The actual amount of cement used might be found to cost less than the larger amount of cheaper cement in the thicker joints. The fact that the modern cements set hard at ordinary air temperatures gave them a very resistant joint at the beginning of their heating schedule. For this reason he advocated their use.

Durability of Linings

Some interesting points were prompted by Mr. Roxburgh's remarks as to durability. In some cupolas the melting zone was rebricked every day. Instead of a process of filling in with ganister, the cupolas were rebricked. This raised an interesting point in regard to the quality of the bricks. For rebricking the melting zone of the cupola, it was useless having a brick that was only half as good again. If they were going to change over at all to a superior type of brick, they must have one that was at least twice as good. If they could get a brick that was twice as good, it would probably last two days and would pay for itself. A silica brick might be developed for that purpose, and it might be possible to produce a brick that, although it would be inevitably a little more expensive, would last longer. If it would last twice as long, it would pay them to use it. If, however, they got a brick that would last only half as long again, it would not have so much advantage over the ordinary cupola brick for rebricking purposes.

MR. W. J. GARDNER said that, personally, after 45 years of experience in the silica industry, he very much doubted whether anything that silica brickmakers could do would substantially help foundrymen toward seeking a cure for all their ills. He did not say they could not do anything.

Differentiating Between the Zones

MR. TUCKER said he thought that one of the main points that would probably arise from Mr. Rees' Paper was that foundrymen would be inclined more and more to keep accurate records of their cupola refractory costs, for this was the basis upon which refractory manufacturers must stand or fall. The whole question was as to whether it was going to pay. Mr. Rees had brought out very clearly the different conditions that might lead to the destruction of a firebrick, and shown how that a particular firebrick that might stand up to one condition might be very susceptible to others. The question was whether cupola users put the same brick in every zone in their furnace. Blast-furnace people had come up against exactly the same problem. They were now going in for a 40 to 42 per cent. alumina brick, and were finding that it had a greatly increased life. The viscosity of the slag was another important point in cupola work. He had been hoping that Mr. Rees would give them some idea of the resistance of Sheffield ganister to slag.

MR. REES observed that Mr. Gardner, like himself, realised that brickmaking in general was still only an art. They were just beginning to make it a science. At present it was in a state of transition from an art to a science. They were realising more and more the real necessity for continued research in the laboratory and works. When, in continuing that research, they investigated the matrix of the bricks as well as the crystalline form of silica present, they would be able to make more progress. He was glad that Mr. Tucker had emphasised the importance of costs records. The knowledge of the cost of refractories to every ton of metal melted was of enormous value in cupola work. Such information would enable a foundryman to evaluate his refractory materials. If he knew how much his cupola lining was actually costing him per ton of iron melted, he had a figure to work upon. In his experience of some cases, where such figures had become available, it had been noted that the cheaper materials had really proved the most expensive in the end. Mr. Tucker had also

(*Concluded on page 444.*)

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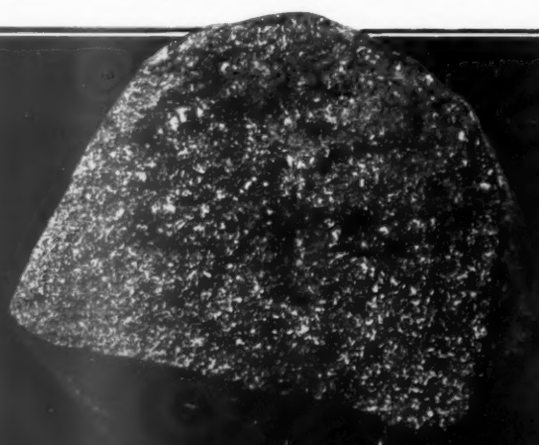

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PIG IRON

This Week's News in Brief

Trade Talk

DURING THE LAST two months new contracts have been secured by the 20 producing shipyards of the Clyde at the rate of £1,000,000 a week.

SIR HERBERT AUSTIN, who was accompanied by Sir William Firth, visited the Ebbw Vale Company's works recently and inspected the sheet mills.

THE TONNAGE of mercantile vessels ordered from British yards by British owners during the past eight weeks was greater than that of the previous eight months.

THE LEIPZIG FAIR, which is to be held from March 1 to March 9 next year, is to be larger than ever. Two escalators have been erected in Hall 9, which houses the heavy-machinery exhibits.

IMPORTS OF CAST PIPES and fittings into India during the nine months, January 1 to September 30, 1935, fell from 1,829 tons to 937 tons, of which 859 tons were obtained from the United Kingdom.

MESSRS. SWAN, HUNTER & WIGHAM RICHARDSON, LIMITED, Wallsend, have received an order to construct another all-welded vessel for the Quebec & Ontario Transportation Company, Limited, of Montreal. The new vessel will be of 2,087 tons gross.

MESSRS. W. PICKERSGILL & SONS, LIMITED, Sunderland, have received an order to build a 9,000-ton motorship for the Hebburn Steam Ship Company, Limited. The engines will be supplied by the North-Eastern Marine Engineering Company, Limited, Wallsend.

MESSRS. GJERS, MILLS & COMPANY, LIMITED, are to light up a blast furnace at their Ayresome Ironworks, Middlesbrough, during the first week of the new year. The firm have already two furnaces producing hematite, and the additional unit is to be engaged on the production of ferro-silicon.

TWO LIGHT PLATE-ROLLING MILLS at Milnewood Works, Mossend, are to resume operations. The works belong to Messrs. Smith & McLean, and are a subsidiary company of the big Colville combine. The two mills have been at a complete standstill for the past eight years. It is reported that the mills will be restarted about the New Year.

THE MERGER of eleven companies engaged in the light castings, which was reported in these columns last week, has now been completed, and the new company, which will have its registered office in Glasgow, has been incorporated under the name of Federated Foundries, Limited. Mr. William Rennie of Messrs. David King & Sons, Limited, has been appointed Chairman of the holding company.

FURTHER DETAILS are now available of the company which, as intimated in our last issue, has been formed to carry on the selling activities of the British Iron and Steel Federation. The British Iron and Steel Corporation, Limited, has been registered as a "private" company with a nominal capital of £1,000 in £1 shares. The objects are to carry on the business of dealers in and importers and exporters of iron, steel, metals, and minerals, manufacturers of and dealers in iron and steel products and alloys, miners, metallurgists, chemists, manufacturers of chemicals and manures, distillers, dye makers, gas producers, manufacturers and letters on hire of and dealers in machinery, gears, apparatus, tools and engineering products, etc. The subscribers (each with one share) are:—Jas. Henderson, Chairman of Committees, British Iron and Steel Federation, and I. F. L. Elliot, Commercial Director of British Iron and Steel Federation. The first directors are the Rt. Hon. Earl of Dudley and I. F. L. Elliot.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

W. McGowing & Company, Limited, 161, Midland Road, Leyton, London, E.10.—Capital: £3,000 in £1 shares. Engineers, founders, sheet-metal workers, etc. Directors: J. A. Gowing and A. S. Perkins.

Ridsdale & Company, Limited, 3, Wilson Street, Middlesbrough.—Capital £300. To take over the business of analytical and metallurgical chemists carried on by Ridsdale & Company. Directors: N. D. Ridsdale (permanent managing director) and Mrs. D. Ridsdale.

Personal

MR. GAVIN COOPER, who has been in the sales department of Colvilles, Limited, Glasgow, has been appointed manager of the firm's London office, and will shortly be transferred to take up his duties there.

MR. T. D. BURNETT has been appointed representative of Messrs. Edgar Allen & Company, Limited, Sheffield, in South-West England, in succession to Mr. A. P. T. Taylor-Gill, who has been appointed special representative for China.

MR. THOMAS CARTWRIGHT, foreman moulder at Dalzell Steel Works, Motherwell, has, on his retirement after 37 years' service with the firm, been made the recipient of handsome gifts, consisting of a wireless set and a wallet of notes, with an umbrella for Mrs. Cartwright.

MR. W. J. GARDNER, managing director of the Meltham Silica Firebrick Company, Limited (a subsidiary of General Refractories, Limited), has been elected a director of Usines Belges de la Général Refractories Seilles-Andenne, Belgium, where it is proposed shortly to begin the manufacture of silica bricks and coke-oven refractories.

MR. ROBERT LEMOINE has been awarded the Gold Medal of the French Foundry Technical Association. Mr. Lemoine took part in the founding in 1924 of the *Ecole Supérieure de Fonderie*, to which he has since been attached, first as demonstrator and then as lecturer. He has taken an active part in the work of the Association, of which he is a member of Council. The Silver Medal of the Association has been awarded to Mr. André Debar, and the Bronze Medal to Mr. Raymond Guérin.

Wills

NAYLOR, WILLIAM, formerly connected with Messrs. Brown & Naylor, Limited, brassfounders and finishers	£1,578

Obituary

MR. JOHN MCARTHUR, who has died at the age of 77, was for more than 25 years employed by Messrs. Smith & Wellstood, ironfounders, Bonnybridge.

MR. J. A. CRABTREE, head of the firm of J. A. Crabtree & Company, Limited, electrical switchgear manufacturers, Lincoln Works, Walsall, died on Tuesday, December 3, aged 49. He founded the company about 16 years ago.

Contracts Open

New Delhi, January 2.—Two 10-ton, one 15-ton and two 30-ton overhead electric travelling cranes and a quantity of spare parts, for the Indian Stores Department. The Department of Overseas Trade. (Reference T.Y. 5,529.)

Stanley, December 14.—2,000 lineal yds. of 4-in. dia. cast- or spun-iron pipes, with specials and fittings, for the Urban District Council. Mr. A. W. Quibell, surveyor, Council Offices, Coach Road, Outwood, near Wakefield.

Audley, December 14.—4,650 lineal yds. of 10-in. dia. cast-iron rising main and construction of a pumping station on piled foundations, for the Newcastle-under-Lyme Rural District Council. Mr. S. E. Lovatt, clerk, Council Offices, Croft Street, Newcastle-under-Lyme. (Fee £3 3s., returnable.)

Presentation to Mr. Ellis Smith, M.P.

Last Saturday, patternmakers employed at the Metropolitan-Vickers Electrical Company met at the Victoria Hotel, Manchester, to congratulate one of their number, Mr. Ellis Smith, the newly-elected member for Stoke-on-Trent. Mr. J. E. Cooke presided and was supported by Mr. W. Jolley (Foundry Superintendent), Mr. R. W. Kemlo (General Foreman), Messrs. H. V. Grundy and A. Phillips (Assistant Superintendents) and staff of the various sections of the foundry department, about 100 people being present. On behalf of those present, Mr. Jolley presented Mr. Smith with a gold watch and, speaking for Mr. G. E. Bailey (Managing Director), he expressed the regret which he (Mr. Bailey) felt at being unable to be present. Mr. Smith fittingly responded.

Institute of British Foundrymen

(Concluded from page 436.)

The activities of Mr. Tom Makemson in the interests of the Institute, as its general secretary, were such that he had not the opportunity to spend many week-ends at his own home; almost every week-end he attended a Committee meeting or visited a Branch. He was also a world-wide traveller.

Other guests whom Mr. Delport mentioned particularly and cordially welcomed were Mr. C. W. Bigg (Vice-President of the Institute), Mr. J. G. Pearce (Director, British Cast Iron Research Association), Captain Sturdy (of the Royal Army Service Corps), and other representatives of the Army.

DR. SMITHELLS, in his response to the toast, voluntarily curtailed his remarks by reason of the late hour. But he did take the opportunity to comment upon the close co-operation between the London Branch of the Institute of British Foundrymen and the London Section of the Institute of Metals, and said that he and his colleagues looked forward to the annual joint meeting to be held during the following week.

During the evening a telegram was received from Mr. Roy Stubbs (Past-President of the Institute) sending greetings and good wishes to President Hurst and all present, and assuring them that he was with them in spirit.

A very jolly evening concluded with the singing of "Auld Lang Syne" and the National Anthem.

Cupola Refractories

(Concluded from page 442)

raised the question of the zoning, and it was a point that ought to be considered in the cupola. It had been considered so far as the blast furnace was concerned. The conditions throughout the cupola were certainly not the same, and he believed it would pay to use in the different zones of the cupola, bricks that were particularly suited to the zones. He agreed with Mr. Tucker as to the importance of the effects of viscosity. If in the cupola the glaze was to be of any use as a protective layer, it must be a very viscous glaze and strong enough to resist any stress put on it by the falling charge. The question of the slag attack on the patching material was an interesting one, but he was afraid that he had not sufficient time to go into the matter fully. In general, it could be said that the higher the silica content of the patching material the more resistance it normally had to the conditions in the cupola.

Mr. Rees was accorded a vote of thanks on the proposition of MR. C. D. POLLARD, seconded by the BRANCH-PRESIDENT (Mr. A. Whiteley).

Forthcoming Events

Institute of British Foundrymen

DECEMBER 13.

Middlesbrough Branch:—Debate, "That the Scientific Aspect of the Modern Ironfoundry is of Greater Value to the Industry than the Development of Skilled Labour." Proposed by D. Guthrie, and opposed by G. B. Taylor. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.45 p.m.

DECEMBER 14.

West Riding of Yorkshire Branch:—Open discussion on subjects raised by members at the Technical College, Bradford, at 6.30 p.m.

Newcastle-upon-Tyne Branch:—Discussion on "Strickle Moulding of Large Castings," at the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6.15 p.m.

Scottish Branch:—(1) Paper on "Metal Spraying"; (2) Annual Dinner.

East Midlands Branch:—"A Comparison of Some Melting Furnaces in a Grey Iron Foundry." Paper by T. R. Twigger, at the College of Technology, Leicester, at 6 p.m.

The Institute of Vitreous Enamellers

DECEMBER 12.

London:—"Heat-Resisting Alloys," Paper by J. Ferdinand Kayser, at British Industries House, Marble Arch, London, W.1, at 8 p.m.

XUM

By courtesy of the Watford Foundry Company Limited

W'BRO' RIXON'S No.3 Foundry Iron

In the foundry illustrated above, thin-walled rain-water pipes are being produced with Rixon's W'bro' Foundry Pig Iron.

FLUIDITY

The high phosphorus content of this iron ensures the fluidity necessary to secure clean, sharply-moulded light castings. The analysis is as follows:—

	Per cent
Silicon	3.29
Sulphur	0.025
Phosphorus	1.65
Manganese	0.34
Graphitic Carbon	3.52
Combined Carbon	0.12
Total Carbon	3.64

The Stanton Ironworks Company Limited, Near Nottingham

Raw Material Markets

There has been a distinct slackening in the volume of business during the past week, but, with the approach of the annual stocktaking period and the Christmas holidays, this was to be expected. With their present requirements covered, consumers will not again enter the market on forward account until the New Year. There has been a slight increase of business in the steel-export trade, and the home situation is still regarded with optimism. Interest has been aroused by the formation of the British Iron and Steel Corporation, which is to carry on the commercial activities of the Iron and Steel Federation. A meeting of the heavy-steel makers was held last week-end, when the question of prices was the main topic of discussion. No change was made.

Pig-Iron

MIDDLESBROUGH.—Messrs. Gjers, Mills & Company, Limited, have announced their intention of putting a third blast furnace into operation in the first week of the New Year at their Ayresome Ironworks. This furnace will be used for the production of ferro-silicon, and so the output of Cleveland foundry iron will not be increased. The three furnaces producing foundry iron in this district continue to be insufficient to cope with consumers' demands. Cleveland ironmasters are becoming increasingly reluctant to contract ahead at current prices because of rising costs. There are no alterations in current quotations. No. 3 Cleveland G.M.B. is 70s. per ton in the Middlesbrough and Falkirk areas, 72s. on the North-East Coast and 73s. on Clydeside.

Home consumption of hematite continues on a heavy scale, and, in some instances, manufacturers are consuming the bulk of their production in their own steel plant. The cost of raw materials has further increased, but, as yet, the advance in production costs has not been passed on to the consumer. Offers of orders at current prices for 1936 delivery are plentiful, but makers are still refusing to book. No. 1 East Coast hematite continues to be quoted at 71s. per ton in the Middlesbrough area, 72s. on Tyneside, 73s. 6d. North-East Coast, 74s. Scotland, 78s. 6d. Sheffield, and 84s. 6d. Birmingham.

LANCASHIRE.—Recent forward transactions have been of only minor importance, but with a satisfactory flow of delivery instructions the December total is expected to reach a good level. The Lancashire textile-machinery trade remains inactive, but machine-tool makers, general and speciality engineers, the light-castings trade, and heavy electrical engineering concerns are all taking regular deliveries. Hematite prices are unchanged on the week. Local consumers are taking up larger tonnages. For delivery to users in the Lancashire price zone, Derbyshire, Staffordshire and Lancashire brands of No. 3 pig-iron are offered on the basis of 78s. per ton, with Northamptonshire at 76s. 6d. and Scottish foundry at 83s. to 83s. 6d. East Coast hematite is on offer at from 80s. 6d. to 81s. per ton, and West Coast material at 81s., both delivered equal to Manchester.

MIDLANDS.—There has been a further increase in the number of inquiries for pig-iron, and many ironfounders are now covered until the end of September, 1936. Quotations are 72s. 6d. for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, including delivery to Birmingham and Black Country stations, with 11d. per ton more if delivered into works in 10-ton lots. Substantial buyers receive a small sliding-scale rebate. The demand for forge pig-iron is on a good scale, and the price remains at 4s. to 5s. per ton below No. 3 foundry. The call for special iron and hematite continues to be satisfactory. Quotations, including delivery in this district, for low-phosphorus iron are between 89s. and 92s. 6d., Scottish is 90s., medium-phosphorus 77s. 6d. to 80s. 6d., and refined iron varies from £5 12s. 6d. to £7 10s. per ton. Hematite prices are firm, with every prospect of being advanced in the near future. West Coast mixed numbers are £4 4s. 6d., East Coast No. 3 £4 3s. 6d., and Welsh £4 3s. for mixed numbers, delivered Birmingham and district stations, with 1s. 6d. extra if delivered into works.

SCOTLAND.—Active conditions prevail in this area, and all descriptions of pig-iron are going freely into consumption. The official minimum price of No. 3 foundry remains unchanged at 74s., at furnaces, with 2s. 6d. extra for No. 1. Makers of light castings remain active, and quotations for No. 3 Cleveland are unaltered at 70s. f.o.t. Falkirk and 73s. f.o.t. Glasgow. Other English foundry irons are quoted at 1s. 3d. per ton below these figures. Local steelworks are finding it increasingly difficult to obtain adequate fuel for their needs, and they are having to draw on their stocks. Steel-making irons are unchanged, and are quoted as follow:—Mixed numbers, Scottish hematite, 73s. 6d.; mixed numbers West Coast hematite, 74s.; mixed numbers East Coast hematite, 74s.; basic, British and Indian, 70s. (less 5s. rebate), all delivered local steelworks.

Coke

Very strong conditions continue to rule in the foundry-coke market, and heavy tonnages have recently been placed. The ironfounders' requirements are on such a scale that many collieries are finding it difficult to meet the calls. For delivery in Birmingham and district best Durham coke is quoted from 39s. to 41s. 6d., and Welsh from 35s. to 46s. At the moment there are no supplies of Scottish coke available.

Steel

The rather quieter conditions which recently developed in the steel trade are likely to rule until the end of the year; but there are signs that the usual slack period will be shorter than usual, says the official report of the London Iron and Steel Exchange. In most departments of the steel trade the manufacturers are inclined to welcome a lull in new business as it will give them some opportunity to overtake deliveries which have been falling into arrears. There has been no relaxation in business in the semi-finished steel department, and consumers are finding it difficult to secure their full supplies. Additional quantities of Continental steel will shortly be available for users in this department. In the meantime, in spite of the heavy deliveries which are being made, there is considerable pressure to place fresh business. The demand for finished-steel products has been affected by the approach of the end of the year and the annual stocktaking period. The business transacted has consisted principally of small parcels, but it is anticipated that a revival in demand will take place so soon as the holidays are over. There has been an increased volume of inquiry on export account, but business with overseas markets is rather disappointing.

Scrap

Steelmakers are still refusing to offer more than 52s. 6d. per ton for heavy-steel scrap on the Cleveland market. Machinery cast-iron scrap has a heavy demand at 57s. 6d., while good, clean, light cast iron has advanced to 46s., but supplies are still scarce. Conditions on the Midland scrap market remain steady, with a good demand for all qualities. Prices are firm. Heavy machinery metal in cupola sizes is at 57s. 6d., good heavy at 50s. and clean light at 47s. 6d. Short, heavy steel scrap as used in the foundries has advanced to 60s. per ton, delivered works. Quotations on the Scottish market are very firm, and the demand is good. Heavy mild-steel melting scrap in furnace sizes from local sources remains at 50s. per ton, with heavy basic at 45s. Heavy machinery cast-iron scrap has a good demand at 60s. to 61s. 6d., while ordinary cast-iron scrap is around 57s. 6d. per ton, f.o.t. consumers' works.

Metals

Copper.—There has been some improvement in the tone of this market, but business continues to be on a somewhat restricted scale. Stocks are expected to show an appreciable decline in the near future. In the United States consumers are cautious, but the industrial position is expected to improve considerably in the New Year, and prices of copper should rise.

Daily market prices:—

Cash.—Thursday, £35 13s. 9d. to £35 15s.; Friday, £35 11s. 3d. to £35 12s. 6d.; Monday, £35 17s. 6d. to £36; Tuesday, £35 10s. to £35 11s. 3d.; Wednesday, £35 2s. 6d. to £35 3s. 9d.

Three Months.—Thursday, £36 1s. 3d. to £36 3s. 9d.; Friday, £36 to £36 1s. 3d.; Monday, £36 6s. 3d. to £36 7s. 6d.; Tuesday, £35 17s. 6d. to £35 18s. 9d.; Wednesday, £35 10s. to £35 12s. 6d.

Tin.—The decision of the International Tin Committee to raise the production quota to 90 per cent. of standard for the first quarter of next year was, perhaps, unexpected, but it seems that the committee is at last facing the facts. The market has been encouraged by the November statistics, which were more favourable than had been anticipated, but prices show a decline on the week.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £222 to £222 5s.; Friday, £222 15s. to £223; Monday, £221 to £221 10s.; Tuesday, £219 15s. to £220; Wednesday, £219 to £219 10s.

Three Months.—Thursday, £211 to £211 5s.; Friday, £212 to £212 5s.; Monday, £210 10s. to £210 15s.; Tuesday, £209 10s. to £209 15s.; Wednesday, £208 5s. to £208 10s.

Spelter.—This metal continues to be disappointing, and there has not been sufficient business to keep prices steady. Though the galvanising industries remain poor consumers, consumption generally has been of a satisfactory nature. In the United States, November figures indicate a reduction of 10,000 tons in the stocks.

Official quotations were as follow:—

Ordinary.—Thursday, £15 12s. 6d.; Friday, £15 8s. 9d.; Monday, £15 12s. 6d.; Tuesday, £15 8s. 9d.; Wednesday, £15 2s. 6d.

Lead.—Consumption of this metal has been well maintained, both in this country and on the Continent. Actual demand on the part of consumers has declined, but statistically the position of the metal is sound.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £17 11s. 3d.; Friday, £17 7s. 6d.; Monday, £17 11s. 3d.; Tuesday, £17 5s.; Wednesday, £16 17s. 6d.

GANISTER

Purchase your supplies from actual Producers with over 50 years' reputation

Scientifically treated, specially ground Ganister for Cupolas, Iron & Steel Works, &c.

SPECIAL LADLE GANISTER

TRIAL BAGS FREE
Quotations on application

The ASTBURY SILICA CO.
CONGLETON, Cheshire
Est. 50 Years

IDAHO PINE
YELLOW PINE

PRIME & PATTERN GRADES
½" to 3" thick
Width up to 24" wide
All free of centre heart and shake

CHETHAM TIMBER
Co., Ltd.,
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LONDON, E.C.2
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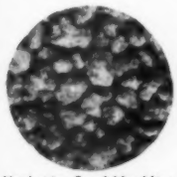
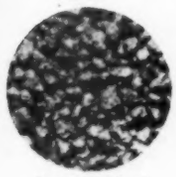
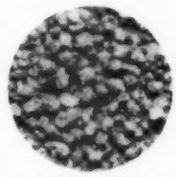
MOULDING SANDS—from our own quarries—milled in our own works

—to your specification

STEEL Moulding Sands, Iron and Non-ferrous Moulding Sands of every type—there are over fifty different grades from which to choose—are produced by us at centres situated throughout England and Scotland. With these facilities, the founder is able to gain considerable advantage by having sand delivered at low Railway rates. You cannot do better than specify a G.R. Sand whether you require it Coarse, Medium or Fine in grain and either well or weakly bonded. The Micro-photographs reproduced on the right—magnified eight times—show the remarkable grain structure of just six of the Moulding Sands we supply. Information regarding the most suitable sand for your particular need and full technical details will be given without obligation.


Yorkshire Steel Moulding Sand


Zenith Red Sand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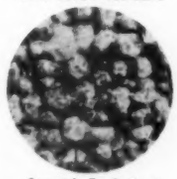
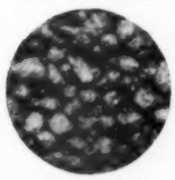
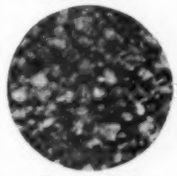

Scottish Rock Sand


Bramcote Red Medium Sand


Bramcote Red Superfine Sand

Please write for further particulars

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SCOTTISH OFFICE: 156, St. Vincent Street, Glasgow. Telephone: 5250.

RAW MATERIALS—PRICE LIST

(Wednesday, December 11, 1935)

COPPER

	£ s. d.
Standard cash	35 2 6
Three months	35 10 0
Electrolytic	39 5 0
Tough	38 0 0
Best selected	38 10 0
Sheets	66 0 0
India	49 10 0
Wire bars	40 5 0
Ingot bars	40 5 0
H.C. wire rods	43 15 0
Off. av. cash, Nov.	35 5 4¾
Do., 3 mths., Nov.	35 12 8½
Do., Sttlmnt., Nov.	35 5 4¾
Do., Electro. Nov.	39 12 1 5/16
Do., B.S., Nov.	39 2 6
Do., wire bars, Nov.	39 16 3
Solid drawn tubes	10½d.
Brazed tubes	10½d.
Wire	6¼d.

BRASS

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅞d.
Wire	7¾d.
Rolled metal	7¼d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£ s. d.
Standard cash	219 0 0
Three months	208 5 0
English	219 5 0
Bars	220 5 0
Straits (nom.)	223 0 0
Australian (nom.)	219 0 0
Eastern	216 5 0
Banca (nom.)	220 0 0
Off. av. cash, Nov.	226 16 10½
Do., 3 mths., Nov.	212 18 2½
Do., Sttlmt., Nov.	226 15 11½

SPELTER

	£ s. d.
Ordinary	15 2 6
Remelted	14 0 0
Hard	12 0 0
Electro 99.9	17 6 3
English	16 0 0
India	13 10 0
Zinc dust	19 0 0
Zinc ashes	4 15 0
Off. aver., Nov.	16 5 7⅜
Aver. spot, Nov.	16 3 10½

LEAD

	£ s. d.
Soft foreign ppt.	16 17 6
Empire (nom.)	18 0 0
English	19 0 0
Off. average, Nov.	17 18 8 9/16
Average spot, Nov.	17 18 9

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	23 12 6
Do., V.M. ex-whse.	24 12 6
Rods	28 10 0

ANTIMONY

	£ s. d.
English	76 0 0 to 77 0 0
Chinese, ex-whse.	64 0 0
Crude, c.i.f.	33 10 0

QUICKSILVER

	£ s. d.
Quicksilver	12 7 6 to 12 18 6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	12 15 0
75%	17 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£18 0 0 to £20 0 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	33 0 0
4/6% car.	21 15 0
6/8% car.	21 0 0
8/10% car.	21 0 0
Ferro-chrome—	
Max. 2% car.	33 10 0
Max. 1% car.	36 5 0
Max. 0.70% car.	37 5 0
70% carbon-free	9½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to 11 5 0
76/80% packed	£11 15 0 to 12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	3 0 0	to 3 2 6
Mixed iron and steel	2 15 0	to 2 17 6
Heavy cast iron	2 14 0	to 2 15 0
Good machinery	2 17 6	to 3 0 0
Cleveland—		
Heavy steel	2 12 6	
Steel turnings	1 17 6	
Cast-iron borings	1 7 6	
Heavy cast iron	2 15 0	
Heavy machinery	2 17 6	
Midlands—		
Light cast-iron scrap	2 7 6	
Heavy wrought iron	3 0 0	
Steel turnings	1 16 6	
Scotland—		
Heavy steel	2 10 0	
Ordinary cast iron	2 17 6	to 2 18 6
Engineers' turnings	2 0 0	
Cast-iron borings	1 18 6	to 2 0 0
Wrot-iron piling	3 2 6	to 3 5 0
Heavy machinery	3 0 0	to 3 1 6

London—Merchants' buying prices, delivered yard.

Copper (clean)	29 0 0
Brass	19 0 0
Lead (less usual draft)	15 10 0
Tea lead	12 0 0
Zinc	9 0 0
New aluminium cuttings	72 0 0
Braziery copper	26 0 0
Gunmetal	27 0 0
Hollow pewter	150 0 0
Shaped black pewter	115 0 0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	72/6
Foundry No. 3	70/-
,, at Falkirk	70/-
,, at Glasgow	73/-
Foundry No. 4	69/-
Forge No. 4	69/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	74/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	71/-
,, No. 3 fdry.	75/-
Northants forge	68/6
,, fdry. No. 3	72/6
,, fdry. No. 1	75/6
Derbyshire forge	71/-
,, fdry. No. 3	75/-
,, fdry. No. 1	78/-
Scotland—	
Foundry No. 1, f.o.t.	76/6
,, No. 3, f.o.t.	74/-
Hem. M/Nos. d/d	73/6
Sheffield (d/d district)—	
Derby forge	68/6
,, fdry. No. 3	72/6
Lincs forge	68/6
,, fdry. No. 3	72/6
W.C. hematite	86/-
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	78/-
Staffs fdry. No. 3	78/-
Northants fdry. No. 3	76/6
Cleveland fdry. No. 3	78/-
Dalzell. No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/6
Clyde, No. 3	83/6
Monkland, No. 3	83/6
Summerlee, No. 3	83/6
Eglinton, No. 3	83/6
Gartsherrie, No. 3	83/6
Shotts, No. 3	83/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 12 6	to 9 15 0
Nut and bolt iron	7 17 6	to 8 7 6
Hoops	10 10 0	and up.
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0	and up.
Bolts and nuts, ¾ in. × 4 in.	15 5 0	and up.
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	9 5 0	to 9 7 6
Chequer plts.	10 7 6	
Angles	8 7 6	
Tees	9 7 6	
Joists	8 15 0	
Rounds and squares, 3 in. to 5½ in.	9 7 6	
Rounds under 3 in. to ¼ in. (Untested)	8 12 0	
Flats—8 in. wide and over	8 12 6	
,, under 8 in. and over 5 in.	8 17 6	
Rails, heavy	8 5 0	to 8 10 0
Fishplates	12 5 0	to 12 10 0
Hoops (Staffs)	9 7 0	
Black sheets, 24g. (4-t. lots)	11 5 0	
Galv. cor. shts. (,,)	13 5 0	
Galv. flat shts. (,,)	13 15 0	
Galv. fencing wire, 8g. plain	14 10 0	
Billets, soft	5 10 0	and up.
Billets, hard	6 17 6	to 7 2 6
Sheet bars	5 10 0	to 5 15 0
Tin bars	5 10 0	to 5 15 0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	10½d
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.31
No. 2 foundry, Valley	19.50
No. 2 foundry, Birm.	15.50
Basic, Valley	19.00
Malleable, Valley	19.50
Grey forge, Valley	19.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	40.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.40
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	21/6
,, furnace	17/6 to 18/9
Scotland, foundry	28/-
,, furnace	25/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20 × 14 per box	18/9
,,	28 × 20 ,,	37/6
,,	20 × 10 ,,	27/-
,,	18½ × 14 ,,	19/6
C.W.	20 × 14 ,,	15/6 to 16/-
,,	28 × 20 ,,	33/6 to 34/6
,,	20 × 10 ,,	22/9 to 23/-
,,	18½ × 14 ,,	15/9 to 16/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6 0 0	to £7 0 0
Bars-hammered, basis	£16 0 0	to £16 10 0
Bars and nail-rods, rolled, basis	£15 15 0	to £16 0 0
Blooms	£10 0 0	to £12 0 0
Keg steel	£30 0 0	to £31 0 0
Faggot steel	£18 0 0	to £23 0 0
Bars and rods dead soft, st'l	£10 0 0	to £12 0 0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
Dec. 5 ..	35 13 9 inc.	2/6
„ 6 ..	35 11 3 dec.	2/6
„ 9 ..	35 17 6 inc.	6/3
„ 10 ..	35 10 0 dec.	7/6
„ 11 ..	35 2 6 „	7 6

Electrolytic Copper

	£ s. d.	
Dec. 5 ..	40 0 0 inc.	5/-
„ 6 ..	40 0 0 No	change
„ 9 ..	40 5 0 inc.	5/-
„ 10 ..	39 15 0 dec.	10/-
„ 11 ..	39 5 0 „	10/-

Standard Tin (cash)

	£ s. d.	
Dec. 5 ..	222 0 0 dec.	45/-
„ 6 ..	222 15 0 inc.	15/-
„ 9 ..	221 0 0 dec.	35/-
„ 10 ..	219 15 0 „	25/-
„ 11 ..	219 0 0 „	15/-

Tin (English ingots)

	£ s. d.	
Dec. 5 ..	222 5 0 dec.	40/-
„ 6 ..	223 0 0 inc.	15/-
„ 9 ..	221 0 0 dec.	40/-
„ 10 ..	220 0 0 „	20/-
„ 11 ..	219 5 0 „	15/-

Spelter (ordinary)

	£ s. d.	
Dec. 5 ..	15 12 6 dec.	2/6
„ 6 ..	15 8 9 „	3/9
„ 9 ..	15 12 6 inc.	3/9
„ 10 ..	15 8 9 dec.	3/9
„ 11 ..	15 2 6 „	6/3

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
Dec. 5 ..	17 17 6 dec.	7/6
„ 6 ..	17 12 6 „	5/-
„ 9 ..	17 16 3 inc.	3/9
„ 10 ..	17 12 6 dec.	3/9
„ 11 ..	17 6 3 „	6/3

Zinc Sheets (English)

	£ s. d.	
Dec. 5 ..	24 0 0 No	change
„ 6 ..	23 15 0 dec.	5/-
„ 9 ..	24 0 0 inc.	5/-
„ 10 ..	23 12 6 dec.	7/6
„ 11 ..	23 12 6 No	change

Lead (English)

	£ s. d.	
Dec. 5 ..	19 10 0 dec.	5/-
„ 6 ..	19 10 0 No	change
„ 9 ..	19 10 0 „	„
„ 10 ..	19 5 0 dec.	5/-
„ 11 ..	19 0 0 „	5/-

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	43 6	43 1	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 3
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	73 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4½
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	63 6	66 11½
1931	59 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 7
1932	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6
1933*	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6
1934*	62 6	65 0	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	66 10½
1935*	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	67 6	69 4½	—	—

* Delivered Middlesbrough area. Prior to 1933, prices were f.o.t. furnaces.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOUNDRY FOREMAN, at present engaged in general engineering castings, desires change. Practical and technical education. Age 35.—Box 508, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MAN (32), eleven years' experience pig-iron trade, good salesman, excellent references, desires position Agent or Representative, Scotland, or any district England.—Box 506, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ENGINEER-FOREMAN for Fettling Shop required for steelfoundry in medium- and light-weight castings. Only engineers with good experience in heat-treatment, dressing, welding and modern engineering requirements with previous control of labour and with organising ability will be considered. Reply stating salary, giving full particulars in chronological order, to Box 502, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN MOULDER required for jobbing foundry. Castings to 12 tons weight. Knowledge of green sand, dry sand, loam sand essential. Non-ferrous optional. State age, experience and salary required.—Box 504, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

VITREOUS ENAMELLING.—Manager with chemist experience wanted by progressive firm for large installation enamelling cast and sheet iron. Must be good disciplinarian with first-class experience of similar work. Excellent opportunity for good man. Apply in confidence, with full particulars, to Box 500, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROGRESSIVE Laboratory Assistant wanted for large engineering works having brass and iron foundries. Applicants must have previous analytical and metallurgical experience, and some knowledge of corrosion research methods and testing will be an advantage. Apply giving full particulars as to age, qualifications, experience, and salary required, to Box 510, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

WANTED.—Good second-hand 3-ton geared ladle. State price and condition.—Box 498, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THOS. W. WARD LTD.

Steam TURBO-BLOWER (Thomson-Houston); cap. 15,300 cub. ft. per min.; 36 lbs. press.

Motor-driven BLOWER; 4½" dia. inlet x 2" dia. outlet; direct-coupled to 34-h.p. motor; 100 volts.

Three LANCS. BOILERS; 30' x 8'; 150 lbs. w.p.

Two steel DISH-ENDED RECEIVERS; 13' 8" long x 5' dia.; 475 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

TWO roller-bearing, double-ended Fettling-shop Grinders, complete with new wheels 24 in. by 3 in. on each machine. Thoroughly modern machines in perfect condition; as new. Offered cheap.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Pneulec Royer Sand Thrower, size No. 1.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

FOR SALE.—Rotating Oil-fired Furnace; maker Sir W. G. Armstrong. Complete with Keith & Blackman fan and motor. Counter shafting and all piping. Capacity 350 lbs. Price £150 on site, Glasgow.—Box 490, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TENDER

GREAT WESTERN RAILWAY.

THE Directors of this Company are prepared to receive Tenders for the supply from February 1, 1936, of the undermentioned Iron and Steel Goods:—

3.—Tyres and Rolled-Steel Wheel Centres.
4.—Steel Axles and Forgings.
5.—Iron Bars and Plates.
8.—Steel Castings (Wheel Centres).
9.— do. (Miscellaneous).
11.—Chain.
12.—Tubes and Fittings (Gas, Steam, Electric Conduit, etc.).
13.—Weldless Steel Tubes (Steam and H.P. Gas, Boiler, etc.).
14.—Iron Castings, Pipes, etc.
15.—Galvanised Sheets.

Specifications and Forms of Tender (upon which alone Tenders will be received) may be obtained on application to the Stores Superintendent at Swindon.

Tenders addressed to the undersigned, and marked outside "Tender for Iron and Steel," will be received not later than 10 a.m. on Wednesday, January 1, 1936.

The Directors do not bind themselves to accept the lowest or any Tender.

F. R. E. DAVIS,
Secretary.

Paddington Station,
London, W.2.
December 10, 1935.

MISCELLANEOUS

WE ARE WIREWORKERS making strong Foundry Sieves and Riddles, Fettlers' Wire Brushes of all kinds, Core-Cleaning Brushes, ½ in. to 4 in. dia., etc. Buy direct and get the right article at the right prices.—WILLIAM OLSEN, LTD., Hull.

MISCELLANEOUS—*Continued*

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries.—FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

'Phone: 287 SLOUGH

SAND PLANT

Herbert Whizzer, large size. **£48.**
Brealey Disintegrator, NEW. **£26.**
Pneumatic Riddles, Jackman type. **£9 each.**

SANDBLAST PLANT

BARREL PLANT by Tilghman, *as new*, 60"×40". Price **£240.**
NEW 8'×8' ROOM PLANT, complete. Price **£230.**
CAST IRON ROOM PLANT, 12'×9', complete with 400 cu. ft. motor-driven compressor for A.C. current, in new condition. Cheap.
Several small complete barrel plants in stock.
Genuine Evans 10-ton Crane Ladle. Price **£35.**

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

SELECT YOUR MACHINE FROM THE LARGEST STOCK OF HIGH-CLASS SECONDHAND MOULDING MACHINES IN THE WORLD

Practical Advice Free

THE COLEMAN FOUNDRY EQUIPMENT Co. LTD.
156, STRAND, LONDON, W.C.2.

WHEN THINKING OF SANDBLAST. THINK OF RICHARDSON'S

Established 1887.

We Supply Re-Conditioned & New

SAND BLAST PLANTS AND AIR COMPRESSORS.

Tilghman's, Room, Barrel, Chamber, Rotary Table, Dust Arrester, and Continuous Feed Barrel Plants.

Phone: MIDLAND 2281.
Grams: "SANDBLAST, B'HAM."

R. J. RICHARDSON & SONS, Ltd.,
Commercial Street, Birmingham.